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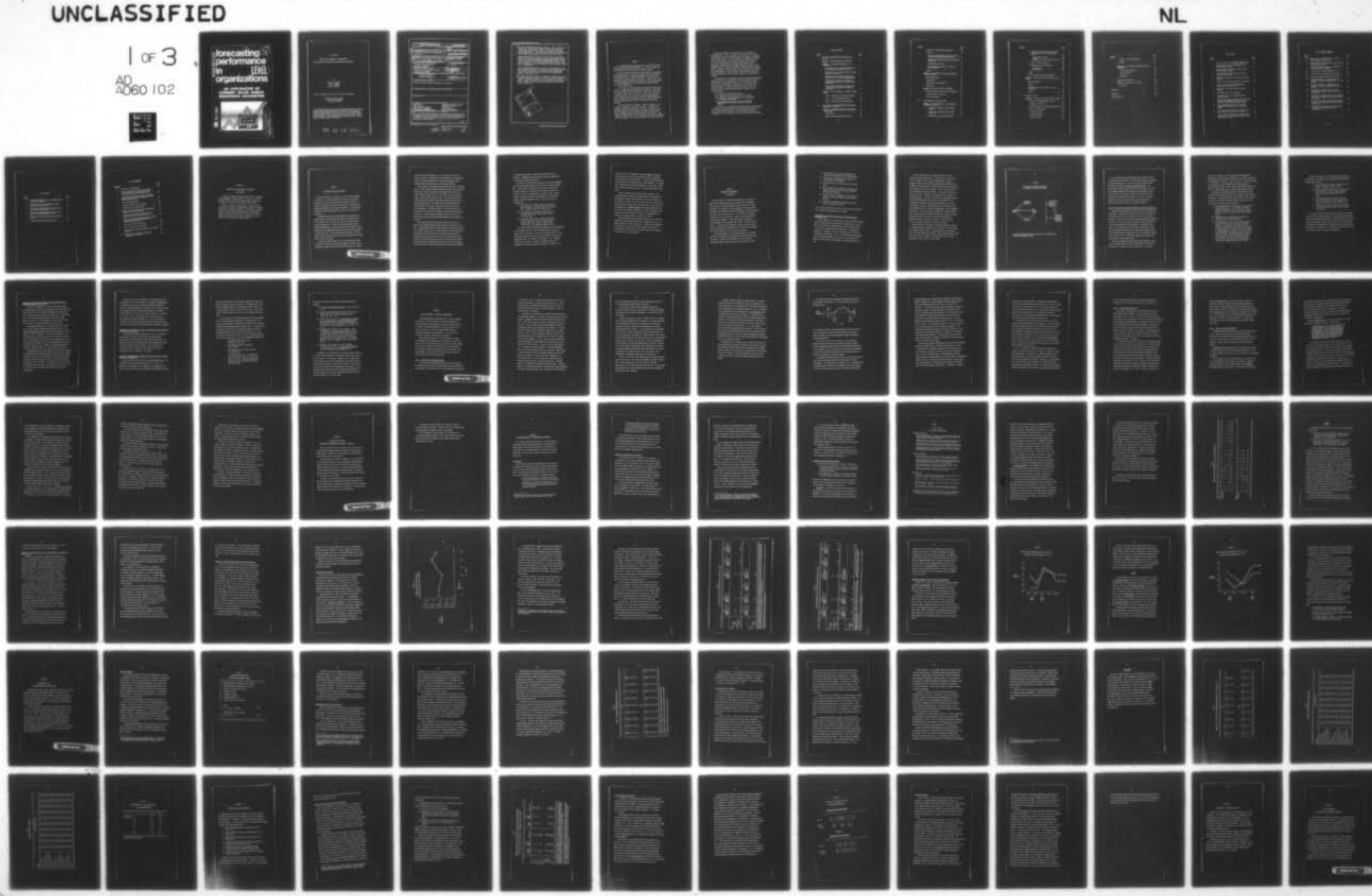

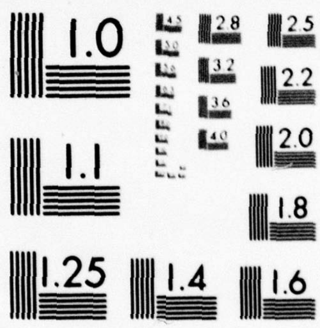

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forecasting performance in organizations

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AN APPLICATION OF CURRENT VALUE HUMAN RESOURCES ACCOUNTING

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Final Report

FORECASTING PERFORMANCE IN ORGANIZATIONS: AN APPLICATION OF CURRENT-VALUE HUMAN RESOURCES ACCOUNTING

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This is the final report describing the development of a current-value human resources accounting (HRA) methodology. Current-value HRA is designed to aid management in decision making. Its goal is to provide information about the effects of organizational policies and practices on the value of organizations' human resources.

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This report summarizes two phases of activity. Phase 1 investigated the nature of the relationship between the human organization and organizational effectiveness. Phase 2, called value attribution, involved three steps: (1) the prediction of changes in performance, (2) the determination of the dollar value of these changes, and (3) the capitalization and discounting of these (future) dollar values.

These procedures were first applied to extant data from business and industry. Two performance measures (total variable expense & absence rate) were predicted by the Survey of Organizations (Taylor & Bowers, 1972), using equations developed via (double cross-validated) linear multiple regression. The theory underlying current value HRA -- that today's management practices affect tomorrow's organizational effectiveness -- was supported.

Second, the basis was laid for extension of current-value HRA to the Navy. Multivariate analyses were conducted which indicated significant relationships (in proportions far exceeding chance) between HRMS measures and two sets of Navy performance measures (operational readiness & reenlistment rate).

The results indicate that even small changes in the human organization can yield significant increments or decrements in future performance. A number of procedural and ethical issues, discussed in the report, still remain. However, the findings clearly indicated that current-value systems of human resources accounting are feasible in both civilian and Navy settings.

PREFACE

This report summarizes the development of a current value human resources accounting (HRA) methodology. It is the final report in a series generated by work under contract *N00014-76-C-0362*.

Current value HRA is designed to provide feedback on how management practices impact the value of an organization's human resources. The methodology rests on repeated measurements of both the human organization and *organizational effectiveness. Based on the relation*ship between these two aspects of organizational functioning, changes in *future* performance can be predicted based on measured changes in the human organization.

In this report, findings and conclusions from the previous seven reports are summarized with an emphasis on readability. Toward this end, several tables containing statistical results have been placed in appendices rather than in the text. In a few cases, statistical tests performed for earlier reports have been excluded altogether. Readers interested in pursuing these particular findings should refer to the appropriate earlier report, as cited in the text of this monograph.

The report contains five sections. Section I (Chapters 1 to 3) provides an introduction to current value HRA -- its definition, purposes, benefits, and complexities. Section II (Chapters 4 to 6) describes the analytic steps necessary to define the relationship between management practices and organizational effectiveness. The *product of these analyses* is a set of equations to be used in predicting performance changes. This constitutes Phase One of current value HRA.

Section III (Chapters 7 & 8) summarizes the second phase of current value HRA -- value attribution. The current value of changes in management practices is estimated based on the changes in performance they are likely to cause. Two case examples are presented, one using civilian data (Chapter 7) and the other using Navy data (Chapter 8). *The civilian case provides a more* complete illustration of the methodology. However, both case examples support the feasibility and potential power of a current value system of human resources accounting. Section IV (Chapters 9 & 10) discusses issues related to the utilization and implementation of current value HRA. Both procedural and ethical issues are addressed. Finally, Section V (Chapter 11) summarizes the findings.

The purpose of the work reported herein was to develop a methodology using data from "real" organizations. The data used were already in hand and were not collected specifically for this research. Even so, they permit an illustration of the analytic *processes* involved in current value HRA. In addition, because the data are "real," the numeric *products* of the analyses may also be of interest for the following reasons:

(1) as the bases of subsequent analysis;

(2) as important research findings in their own right;

(3) as suggestive of additional issues to be investigated in the Current Value Method;

(4) as an example of the type or range of outcomes one might expect from a functioning current value HRA system.

In conclusion, the research reported herein supports the feasibility of developing current value systems of human resources accounting in both civilian and Navy settings. The next step should be actual implementations in organizations and a study of the utilization process.

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SECTION I:

CURRENT VALUE HUMAN RESOURCES ACCOUNTING: AN OVERVIEW

Current value human resources accounting (HRA) is designed to aid management in decision making. Its goal is to provide information about the effects of organizational policies and practices on the value of organizations' human resources.

Section I provides an introduction to current value HRA. The section is divided into three chapters. Chapter 1 describes the current value accounting system -- its purposes and benefits. Chapter 2 lists the general requirements for developing the system and assesses the feasibility of meeting them. Chapter 3 focuses on the complexities involved in estimating changes in the value of an organization's human resources.

CHAPTER 1

WHY HUMAN RESOURCES ACCOUNTING?

Effective utilization of resources is basic to good management. In the Navy, as in civilian organizations, the types of resources available are diverse and both technical and human in nature. The "technical organization" includes the physical plant and equipment, production technologies, and financial investments. From the "human organization" comes the manpower, work styles, and the motivation to perform.

Organizational leaders have long recognized the importance of technical resources and well-accepted methods for measuring levels of and changes in these resources are found in most organizations' accounting systems (e.g., financial accounting, systems analysis, industrial engineering). The current state of the technical resources and the impact of management decisions on them are usually expressed in dollars and cents. Thus, when managers make choices, the likely impact of their actions on the dollar value of the technical resources enters the decision process.

In contrast, slight attention is paid to monitoring the human organization. Methods for assessing the impact of decisions on the organization's human and social resources remain primitive. Whether

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the cause of this primitiveness is lack of attention or the lack of ability to measure is debatable, but the consequence of not monitoring changes in the human organization is frequently management actions which unwittingly decrease the value of the human resources.

This situation is illustrated by what may be termed the "contingency paradox." Much research evidence indicates that better cost performance occurs under an open, "participative" management system than under a tightly directed, "autocratic" one (e.g., Likert, 1961, 1967; Drexler & Bowers, 1973; Franklin & Drexler, 1976). Yet, when confronted with a need for greater efficiency, management typically moves toward less cost-effective practices. Short-term gains are demanded and often realized through, for example, arbitrary head count reductions and close supervision. The problem, however, is that these gains may be spurious, since costly long-term problems in the human organization may also result. The fact that well-accepted methods do not exist for monitoring the value of human resources perpetuates these traditional practices.

The systems providing organizational leaders and key decision-makers with information about the human resources are deficient in two ways. Present systems commonly provide readings on events and conditions at the outcome stage only, e.g., retention rates for the previous month. The conditions and events leading to the reported outcomes are not indicated, since traditional systems do not include information about the state of the human organization and how this state affects outcomes. Secondly, traditional information systems focus on short-term outcomes and provide little or no data on the relationship of short-run outcomes

to long-range effectiveness. Without these additional kinds of information, management must make decisions based on incomplete and, in some cases, misleading information.

Thus, methods for measuring the impact of decisions and management practices on the human organization are critical to effective management. Several years ago, Brogden and Taylor (1950) proposed that the human resources of an organization be monitored by measuring an individual's value to the organization in financial terms. Recent attempts to gather and compile such measurements are termed human resources accounting (Hermanson, 1964). Three types have been conceptualized:

(1) The "Incurred Cost" method, measuring the amounts already invested in the human organization (Brummet, Pyle, & Flamholtz, 1968; Pyle, 1970a, 1970b).

(2) The "Replacement Cost" method, estimating the cost of replacing the organization's human resources (Flamholtz, 1969).

(3) The "Present Value" method, estimating the future productive potential of current human resources (Likert, 1967; Likert, Bowers, & Norman, 1969; Likert & Bowers, 1973; Bowers & Pecorella, 1975).

This report focuses on developing and demonstrating the methodology for the Present Value, also called the Current Value, approach to human resources accounting. The Current Value approach rests on the relationship between the current state of the human organization and future performance. Two features are emphasized. One is time-lag: a belief that the effects of "today's" management practices on performance are felt most strongly, not today, but "tomorrow." The

second key point is its emphasis on assessing <u>change</u> in the human organization and in future performance rather than on determining the absolute value of human resources. The phrase "Future Performance Trend Indicators" (FPTI) embodies both of these concepts. It stresses that a human organization that is managed now in a way that is better than at some time in the past results in greater effectiveness in the future.

Future performance trend indicators predict changes in such outcome measures as productivity, production costs, and absenteeism. These predicted changes, when converted to their dollar values, can be discounted to reflect the timing of their predicted occurrence, and then capitalized to reflect their investment value. These values are the <u>current</u> value of <u>measured changes</u> in the human organization which will cause future changes in performance. While the description here expresses the value of changes in dollars, the same procedures are applicable to outcome measures not expressed in dollars.

Future performance trend indicators pin-point areas of the human organization needing improvement before the problems show up as, e.g., higher absenteeism or lower productivity. In addition, the importance of effectively utilizing human resources becomes more obvious to decision-makers since the state of the human organization is measured in units familiar to the organization.

CHAPTER 2
FORECASTING PERFORMANCE:
IS IT POSSIBLE?

Potential payoffs of forecasting performance as a function of changes in the human organization include significant improvements in performance that better management of human resources can foster. Nevertheless, few organizations have attempted to incorporate future performance trend indicators into their management information systems. Two beliefs help to explain why not: first, that HRA is unethical, and second, that it is unfeasible. Ethical issues surrounding HRA are discussed in Chapter 10. Basically, however, objections on ethical grounds concern uneasiness about placing a monetary value on workers. In addition, brash attempts to assess the value of human resources might produce side effects such as suspicion and resentment which would decrease the value of those very resources.

The second objection is that human relationships, motivations, behaviors, and attitudes cannot be measured with the desired degree of accuracy. Indeed, the development of a current value HRA methodology hinges on several conditions (Likert & Bowers, 1973):

(1) The availability of scientific knowledge which identifies key dimensions of human organizations;

(2) The adequacy of methodology and instruments for measuring these key dimensions;

(3) The availability of reliable and valid performance data;

(4) The availability of knowledge of the relationships between key dimensions of the human organization and performance outcomes;

(5) The availability of knowledge of the persistence of changes in the human organization after they have occurred;

(6) A statistical technique for computing the current value of the human organization.

Each of these conditions and the extent to which they have been met are discussed in the remainder of this chapter.

Key Dimensions of the Human Organization and Their Measurement (Conditions 1 & 2)

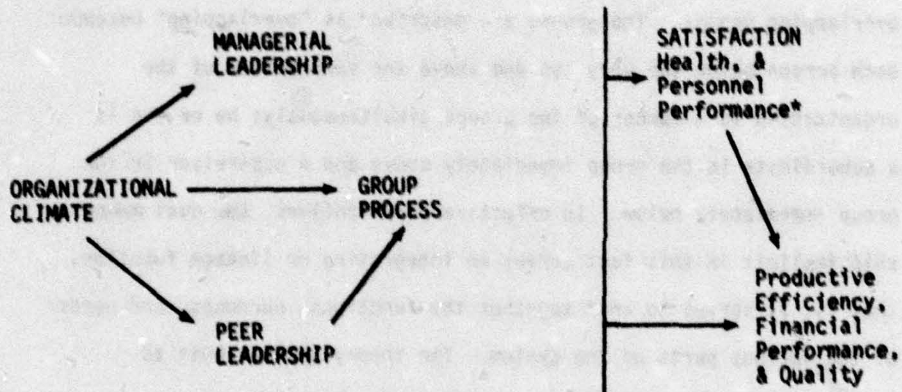
Several theories in the psychological literature propose conceptual models for understanding the functioning of organizations. Most of them lack the necessary comprehensiveness, however, focusing on one or two isolated constructs such as "motivation" or "interpersonal relations." In addition, few focus on the causal flow of events in organizational functioning -- that is, on what behaviors and attitudes of which organization members at one point in time, trigger other behaviors and attitudes of other members at some different point in time.

Likert's meta-theory, which places behaviors in a causal-intervening-end result sequence is an exception (Likert, 1961, 1967, 1976, 1977; Bowers, 1976). Briefly, organizational climate and managerial leadership are viewed as the major causal variables, peer leadership and group process as intervening variables, and satisfaction and performance as end result variables. Figure 1 shows graphically the relationships among these variables. This causal flow of events takes place within a framework of the organization as a system of overlapping groups. The groups are described as "overlapping" because each person below the very top and above the very bottom of the organization is a member of two groups simultaneously; he or she is a subordinate in the group immediately above and a supervisor in the group immediately below. In effective organizations, the dual membership implicit in this fact serves an integrating or linkage function, that is, it serves to knit together the functions, purposes, and needs of the various parts of the system. The theory applies best to organizations with a hierarchy of authority. This includes the majority of business, industrial, and military settings.

Equally important, the theory is supported by empirical evidence. Its comprehensiveness has been tested in a variety of civilian settings (e.g., Bowers & Franklin, 1976). Its applicability to two military services has been tested as well (Bowers, 1975; Wessner & Franklin, 1975) and its major causal statements have been examined across time and organizational level (Franklin, 1975a, 1975b).

Figure 1

Relationships between Major Social-Psychological Factors and Outcomes



*Personnel performance includes such factors as retention rate, discipline, and absence rate.

A survey method has been developed by Taylor and Bowers (1972) for measuring the key dimensions in Likert's meta-theory with reasonable accuracy and objectivity. It utilizes a standard, machine-scored questionnaire entitled the Survey of Organizations (SOO). The questionnaire has been used extensively for both diagnostic and information feedback purposes within organizational development studies in both civilian (e.g., Bowers & Franklin, 1976) and military (e.g., Michaelson, 1973; Spencer, 1975) settings. Thus, the first set of conditions can be met utilizing Likert's theory and the survey methodology developed to measure its principal dimensions.

Availability of Valid and Reliable Performance Indicators (Condition 3)

Organizations typically employ multiple criteria to evaluate their effectiveness. Some criteria are directly related to the organizations' cost-effectiveness such as recruitment and training costs, quality, and quantity in relation to a production standard, equipment and material utilization. Other criteria, such as retention rate and satisfaction, are indirectly related to cost-effectiveness: dissatisfaction contributes to low retention rate; low retention rate results in higher total recruitment and training costs. Business and industrial organizations commonly view cost-effectiveness as the final outcome. However, "quality of work life" is increasingly viewed as an important aspect of organizations' social responsibility.

While most organizations collect outcome data pertinent to one or more of the above criteria, there are several potential constraints on accuracy. Two types of accuracy are important: validity and

reliability. If data are *valid*, they measure the dimensions of effectiveness they are supposed to measure. Thus, having a definition of effectiveness is essential. Implicit in FPTI is a revised definition of effectiveness, one which emphasizes long-term performance. Performance data that are *reliable* measure effectiveness without error, that is, without problems such as inaccurate performance reporting.

The validity of performance measures is affected by both their definition and the appropriateness of the information used to construct the measures. Concerning definitions, Macy and Mirvis (1976) identified three criteria which performance measures should meet if they are to be used in human resources accounting:

(1) The performance behavior must be significantly affected by the work structure. This excludes, for example, changes in productivity due to fluctuations in demand, since such changes are caused by extra-organizational factors.

(2) The behavior must be measurable and convertible to significant costs to the organizations.

(3) The measurement and cost of each performance behavior should be mutually exclusive of other performance behaviors. For example, a low retention rate results in increased recruiting and training costs and perhaps in reduced readiness. Therefore, when valuing retention rate changes, these elements should be reflected. On the other hand, the costs should not be counted more than once; for example, training costs used to value retention rate should not be included when valuing other outcomes related to that retention rate.

In terms of the reliability of the information collected and used to measure performance, the data become questionable when the following practices occur:

(a) changing performance standards differentially from subunit to subunit or period to period,

(b) maintaining common standards for all subunits when the work nature or mix has changed drastically over time and differentially from subunit to subunit,

(c) clustering performance information, often into cost centers which bear little resemblance to the actual organizational operating structure, and

(d) relying upon collection procedures which systematically distort reported results (Taylor & Bowers, 1972, pg. 82).

It is even possible that outcome data are deliberately "fudged" when the control and reward systems of an organization encourage supervisory and non-supervisory employees to protect themselves by reporting inaccurate performance figures. These situations also pose problems for traditional accounting methods and reports used to assess short-run profitability. Nevertheless, it is important to assess the reliability of the data to be used in forecasting performance.

Knowledge of the Relationship between the Human Organization and Performance Outcomes (Condition 4)

Failure to find meaningful, consistent relationships between socio-psychological and performance properties of an organization seems to stem from limitations in the data or methods used to investigate them. Sometimes the wrong variables are attended to. At other times the correct variables are measured poorly (Katz & Kahn, 1966). Typically, there is a lack of awareness of time lag or insufficient data to assess the time lag operating (Likert, 1961, 1967).

The measurement method and its underlying theoretical rationale in the present study have addressed the problems just cited. The Survey of Organizations (SOO) measures the human organization variables central to Likert's meta-theory. Reliability coefficients for the survey measures have been known for quite some time (Taylor & Bowers, 1972). Some additional characteristics of the organization (e.g., its technology) and its members (e.g., their achievement motivation) can be added in particular cases. However, the standard SOO provides a relatively comprehensive picture of organizational functioning.

The SOO manual presents some evidence of the relationship between the human organization and organizational outcomes for eight companies. Twenty to 30 percent of the coefficients relating the survey indices to measures of efficiency were statistically significant beyond the five percent level of confidence. The majority of these coefficients fell between .25 and .50, with a few reaching values in the low .80's. Similar results exist for measures of attendance for these same organizations.

Evidence of significant relationship of these measures to Navy performance criteria is also available. Relationships of SOO measures to reenlistment rates and to validated reenlistment intentions of individuals have been demonstrated by Bowers (1973). Analyses relating these measures to actual rentention and readiness have also been conducted (Franklin & Drexler, 1976; Drexler & Franklin, 1976; Bowers, et al., 1978). Finally, relationships to discipline rate have been established (Crawford & Thomas, 1975). Thus, when problems in the quality of the survey and performance data are taken into account and solved, the likelihood of finding meaningful relationships increases.

Evidence of the Durability of Changes in Organizational Functioning and Effectiveness (Condition 5)

Little research has been conducted on this topic. A follow-up study (Seashore & Bowers, 1970) of a successful organizational development program suggested that changes in business outcomes and employee attitudes that resulted from the formal change program (1962-1964) had persisted several years hence. This issue needs to be investigated further. However, the data necessary for such an investigation were not available in this study.

A Statistical Methodology for Computing the Current Value of the Human Organization (Condition 6)

This last condition has been met in a technique presented by Likert and Bowers (1973) and expanded by Davenport et al. (1977). The application and refinement of this methodology are presented and discussed in later chapters. Basically, however, the methodology involves

measuring the key dimensions of the human organization at each time period, say one year ago (T_1) and now (T_2). Performance scores from different company divisions are "standardized," which allows us to talk about change in terms of "units" of gain or loss. Thus, one can speak of so many "units" of gain or loss in, for example, production costs.

A positive change in key dimension measures of the human organization will be associated with a decrease in production costs. The amount of this decrease will depend upon the strength of the relationship between the key dimension and production costs. For example, let's assume that this relationship has been established over time for a given organizational unit, and that the correlation is -.70. (The correlation is negative since higher scores on the key dimensions are associated with lower costs.) Also in this hypothetical organization:

. The standard deviation of the key dimension scores is 0.25.

. The standard deviation in production costs is $5.00.

. The organization has an annual production of 100,000 units.

. The organization had at T_1 a key dimension score of 3.60; and it had at T_2 a key dimension score of 3.85. (The key dimensions are measured on 5-point scales with "5" indicating a high score.)

Based on this information, the following computations would be performed:

(1) The gain in the key dimension scores is from 3.60 to 3.85, or +.25.

(2) This gain when standardized by dividing the gain by the standard deviation of the key dimension scores, is +1.00 (+.25 ÷ .25 = 1.00).

(3) In turn, this gain of +1.00 is converted to an estimated gain in standard scores in the unit production costs by multiplying it by the correlation (-.70) between the key dimension scores and production costs (+1.00 x -.70 = .70).

(4) Converting this reduction in unit production costs of -.70 expressed in standard scores to dollars yields an estimated reduction in unit costs of $3.50 (per unit). This conversion to dollars requires multiplying the estimated reduction in standard scores by the standard deviation of the unit production costs (-.70 x $5.00 = $3.50).

(5) The total annual reduction in costs is $350,000 (100,000 x $3.50), that is, the savings per unit multiplied by the number of units produced annually.

The newness of any procedure for making these estimates (relative to the traditional procedures for estimating current fiscal returns), will affect their initial accuracy. However, as the procedures are further developed and refined, the magnitude of errors will decrease and the ability to estimate their size will increase. Even in cases in which the estimates are not overwhelmingly accurate they will be a great deal more accurate than current statements of effectiveness in which the changes in dollar-value of the human organization are not taken into account at all (Likert, 1967).

CHAPTER 3

VALUE ATTRIBUTION: HOW MUCH IS CHANGE WORTH?

Future performance trend indicators (FPTI) involve two phases of activity: first, establishing the relationship between the human organization and performance and second, estimating the value of changes in the human organization. The second phase, called *value attribution*, is a crucial and highly potent aspect of forecasting performance in organizations. It is in fact, the "accounting" feature of human resources accounting.

Value attribution includes: (1) the prediction of changes in performance, (2) the determination of the dollar value of these changes, and (3) the capitalization and discounting of these (future) dollar values to reflect their current value to the organization. Six conditions necessary for developing FPTI were discussed in the second chapter. The present chapter addresses issues especially relevant to each step in value attribution.

Step 1: Prediction of Performance Changes

In the Current-Value methodology, changes in future performance are predicted based on the relationship between the human organization and performance. Key dimensions of the human organization are measured

at two points in time. The human organization scores at Time 1 are related to performance for several time periods ($T_o, T_o+1, \ldots, T_o+k$). Observed change in the human organization from Time 1 to Time 2 is then used to estimate changes in performance expected to occur at specified times in the future.

The accuracy of the predictions is affected by several aspects of the measurement procedure. The quality of the measures used is crucial. Secondly, performance changes are predicted based on specified time lags. If the time lag used is incorrect, the prediction will also be incorrect. Third, the human organization-performance relationship might change between two measurements of the predictors. If it does, the equation used to predict performance changes has to be altered. Fourth, in order to improve predictions, dimensions not part of the human organization, such as organizational size, could be included in the prediction equation. If this is done, however, the effects of the human organization on performance have to be separated from the effects of the other variables. Finally, the level of aggregation -- e.g., individual, work group, department -- for which measurements should be taken and predictions made has to be decided. When the SOO is used to measure the state of the human organization, predictions will usually be made at the work group level. Depending on the organization, however, it might be desirable to aggregate the predicted performance changes to a more inclusive level. An example where this is necessary is provided by the present study. In general, however, it is probably most useful to retain the work group predictions until after costing and capitalizing. Differences in the capitalized

dollar values among work groups can then be compared and the values can be aggregated to whatever level is desirable.

The first three issues affecting performance predictions -- accuracy of measures, time lag, and variation of predictor-performance relationships across predictor measurements -- are discussed in more detail below.

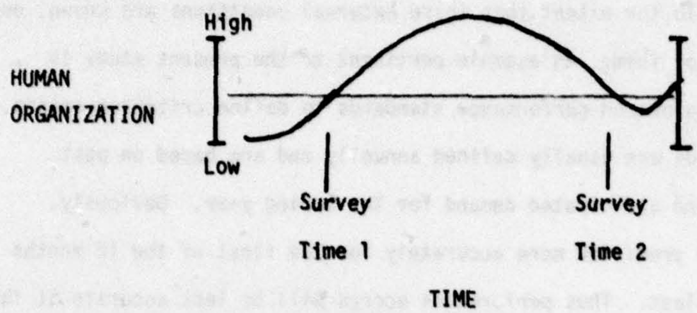
Accuracy of performance measures. The goal of FPTI is to predict various levels of performance in an organization. The model underlying the FPTI methodology postulates that key dimensions of the human organization affect an organization's performance and this model is supported by empirical evidence. Thus, the variability in performance (the criterion) is partly explained by specified organizational conditions and practices (the predictors). Another portion of the variance in the criterion stems from the imperfect reliability of the performance measures usually available, and this places a limit on the magnitude of the predictor-criterion relationship that can be observed. Because of this limit, Bowers and Davenport (1978) reasoned that the observed relationship between the human organization and performance is likely to be weaker, not stronger, than the "true" relationship. Thus, predictions of performance changes may well be conservative.

Time lag. A time lag exists between change in the human organization and the effects of this change on performance (Pecorella & Bowers, 1977). When assigning dollar values to changes in the human organization, this time lag must be taken into account. In the research being reported here, separate prediction equations were developed for each of several time lag values.

The human organization (HO) is measured at Time 1. The human organization consists of climate (C), supervisory leadership (SL), peer leadership (PL), and satisfaction (S). The scores are related to monthly performance (P) for perhaps 24 months ($P_1 \ldots P_{24}$). An equation is then developed to predict performance ($\hat{P}$) for <u>each month</u> based on the human organization scores; for example: $\hat{P}_{12}$=f(HO)=.40C+.30SL+.20PL+.50S. Note that the equation for each performance month can be different. Then we measure the human organization at Time 2 (HO′). These scores are entered into each of the equations to predict performance for 24 months into the future ($\hat{P}_{1 \ldots 24}$). Thus, equation $\hat{P}_{12}$=f(HO′) predicts performance one year from now. Time lag is taken into account by using separate equations for each performance period. The same equation used to describe the human organization-performance relationship originally is used to predict performance due to subsequent changes in the human organization.

An additional issue is whether cyclical patterns that affect the human organization-performance relationship are not visable because of the measurement timing. Monthly measures of performance are probably adequate. However, if the predictors are measured once a year whereas the pattern of changes in the human organization occurs more slowly or rapidly, the ability to predict performance changes accurately is reduced.

The diagram below shows a hypothetical human organization that changed during a 12-month period. Yet it was the same at the two measurement times.



The "unobserved" changes in the human organization can cause fluctuations in performance. These fluctuations would not be predicted however, because the two survey measurements showed no difference in the human organization.

Variation across Predictor Measurements. The relationship between the human organization and performance sometimes changes. *When the relationship changes during the time between two measurements of the predictors, we call it variation across predictor measurements.* If this occurs, the equations developed to predict performance lose validity for prediction of future performance.

The conception of organizations as open, living systems identifies some factors which might produce this variation across predictor measurements. The organization's environment is one. A sudden downturn in general economic conditions could change the relationship between the state of the human organization and effectiveness simply because

measured outcomes come to reflect more the economy than anything else. Seasonal fluctuations in product demand or employee attendance might influence performance measures with little or no change in the predictors. To the extent that these external conditions are known, one may account for them. An example pertinent to the present study is the use of engineered performance standards to define criterion scores. These standards are usually defined annually and are based on past performance and anticipated demand for the coming year. Obviously, demand can be predicted more accurately for the first of the 12 months than for the last. Thus performance scores will be less accurate at the end of the annual period for which standards are computed. If the predictors are consistently measured at the same time relative to the definition of the standard, however, this influence will be constant across predictor measurements. The same approach can be taken with regard to other seasonal fluctuations, whether they arise from sources internal or external to the system.

Changes across predictor measurements which arise from the internal dynamics of organizations are of more direct concern here. Given a relatively stable environment, organizations may change because of internal factors. Changes in personnel, particularly at the upper levels, can have a profound impact. Another potentially powerful influence would be the implementation of planned, systemic, organizational change activities. Activities which strongly impact the human system have a high probability of impacting the relationship of this human system to the organization's effectiveness. For example, if between

measurements of the human system, a technological change increases the task and socio-emotional information available, it is possible that the time lag in the responsiveness of the total organization to the human system would be decreased. Thus, the strongest relationship might be observed at twelve months lag time instead of at 18 months. Clearly, use of the relationships developed under the old technological system would not accurately describe the new system.

It is possible to divide these different sources of variation across predictor measurements into two categories: those which can be identified and whose influence on the relationship can be accounted for in some predictable manner, and those which, while real, are unaccounted for or unplanned. Research may move some factors from the latter category to the former, but this is not likely to be the case for all possible influences. The very fact that we are predicting means we cannot know how accurate our predictions are until after the event. This means that we should examine past predictions to develop means of making better predictions.

Thus, it is important to update the prediction equations continually. One model for this activity involves (1) regular collection of performance data, (2) periodic (e.g., annual) measurement of the human organization, and (3) regular updates of prediction equations which utilize previously collected data. Additionally, as an organization's data set grows, there is opportunity to improve predictions through the use of additional variables. Thus monitoring the predictor-criterion relationships over time allows an organization to understand

more fully the effect of external and internal influences on its performance, on its human resources, and on their relationships.

Step 2: Criterion Change Valuation

Once changes in performance have been predicted, the value of these changes must be determined. There are several reasons for expressing the value in dollars. The dollar is familiar and common in the operation of the organization. This not only makes the predictions more acceptable and understandable to organizational leaders but also means that standard financial accounting procedures can be applied. Costs or savings due to changes in the human organization can be compared to those of changes in other sectors. Cost-benefit analyses could be conducted. However, even though a measure may be highly significant to the organization, it may not be convertible to dollars. Operational readiness is an example.

As noted earlier, the value (or cost) of each performance behavior to the organization should not be counted twice. For example, higher training costs may result from large numbers of new recruits (made necessary by a low retention rate) or from increased absenteeism in jobs which require training of even temporary replacements. When costing retention rate and absenteeism, total training costs must be broken down and assigned to only one outcome -- retention or absence. Furthermore, only variable costs. i.e., those that vary directly with production or activity level should be included since only they are affected by employee behavior (Pecorella & Bowers, 1976a; Mirvis & Lawler, 1977; Davenport, et al., 1977). Fixed costs, which do not

change with employee behavior, should be excluded. Mirvis and Macy (1976) provided an example of costing performance behaviors where variable, fixed, and opportunity costs associated with each behavior were calculated. The feasibility of such a procedure depends on accounting practice, while its desirability depends on its intended use. The illustration of the FPTI methodology herein predicts dollar changes due to changes in the human organization. By definition, fixed costs do not vary with employee behavior and should therefore be excluded.

Step 3: Capitalization and Discounting

The completion of the valuation step in value attribution results in cost changes predicted to occur at specified future times. Discounting and capitalization are two accounting techniques which may be applied to this stream of anticipated income in order to make it comparable to other financial information available for decision making.

Discounting adjusts the magnitude of the predicted cost changes to account for their timing. This is done because the *present value* of x dollars depends on the time at which the x dollars will be received (expended).

The end product of the discounting process is a figure which can be used in managerial decision making. For example, a company is considering whether or not to spend $50,000 on an organizational development project in the next year. If the effect of that project

on the human organization can be estimated, then anticipated changes in effectiveness can be computed, costed, and discounted to present value. The comparison of present value with the cost of the project will aid in the decision of whether or not to engage in the project. Similarly, the present values for a variety of proposed organizational development interventions can be used as a basis of comparison for the different interventions.

The term "capitalization" has a variety of meanings. Our usage corresponds to Guthmann and Dougall's (1955) definition:

> "...capitalization is the process of estimating the present investment value of a property by discounting to present worth the anticipated stream of future income. Thus, if a certain business were expected to yield an income of $50,000 per year perpetually, and 10 percent were judged a fair rate of return upon an investment of that sort, then the value of the business would be $500,000, the result being obtained by the capitalization of income." (p. 76)

In the context of the value attribution process, the "property" is the state of the human organization. The "present worth (of) the anticipated stream of future income" is the present value as computed by the discounting process. Thus, once this present worth has been computed, selection of a fair rate of return permits its capitalization. The rate of return selected is a function of current business conditions as they apply to a particular organization. The accuracy, and therefore, utility, of the capitalized values depends in part on the duration of the expected future stream of income. The more known about an investment, the more accurate are predictions about duration

of the income and year to year fluctuations in the amount of income. As more knowledge is gained about the impact of investments on the human organization, it will be possible to estimate their duration and year to year fluctuation.

The investment values produced by capitalization can be used for two purposes. If they are sufficiently accurate, they may be entered in the financial records of the organization. However, given the probabilistic nature of the current value method of human resources accounting, considerable refinement of the predictions will be required before they can be considered part of the organization's official financial records. The investment value is most useful for making decisions about capital investments. The capitalization of the present values puts them on a par with other capitalized values and allows decisions about the investment in the human organization to be considered in a manner similar to other major investments.

Beyond the issues of duration of expected return and the uses of investment values, two questions remain. First, are there acceptable analogs to the dollar metric? This is important because some significant effectiveness indicators cannot be converted to dollars. Second, does delay add to or detract from the value of a future consequence? Traditional discounting techniques indicate that it does. But the situation for human resources accounting is different.

Are there analogs to the dollar metric? Information about changes in the human organization and anticipated changes in performance must be converted to a form which can be circulated, understood, and used. This conversion is the role of the "output transducer." The valuation,

discounting, and capitalization procedures of the value attribution process are instances of output transduction.

In industry, current value HRA calculates in dollar terms because the dollar is a familiar and influential metric. Other metrics are possible, however. Societal developments suggest that in the years ahead, "quality of life," "social responsibility," or "environmental" metrics will become more prevalent.

In the Navy, however, effectiveness indicators such as operational readiness are not accurately convertible to dollars. Perhaps units of rated readiness could instead be used.

The existence of analogs in the military is highly likely. The difference is that the ties between present and future, investment and return, opportunities and their cost, have not yet been worked through for military organizations. Experts in the fields of military logistics, strategy, tactics, and policy might well provide the needed guidelines.

Traditional notions in Discounting. The whole notion of discounting is customarily stated in terms of desirable outcomes which must be awaited and of alternative benefits which must be foregone during the interim. For example, a company invests in stock with an anticipated return of 30 percent in three years. The five percent annual interest that a savings account would have paid during the three years is subtracted from the return. The stock investment is more lucrative in the long run but carries more risk.

Does delay add to or detract from the value of a future consequence? In the industrial case where a secure, short-term investment exists (i.e., savings accounts), delay does detract from the anticipated return in the form of "dollars of interest" foregone in the interim. Furthermore, dollars are a liquid asset, easily negotiated and reinvested without affecting their value.

In the case of the Navy, the effects of delay are not so clear. Perhaps an ability to realize a substantial increment in readiness ten years hence adds to, rather than substracts from, its present value. For example, if the Navy is reasonably certain that a readiness increase of 60 percent five years in the future will result from a program begun now, other interim investments may be deemed unnecessary. No secure, fast-paying investment analogous to a savings account exists in the Navy setting. Furthermore, readiness units may not be as negotiable as dollars. Changing development strategies where the human organization is involved may have major and long-term effects on readiness that are more recalcitrant then in the industrial setting.

In summary, the issues surrounding value attribution which have been discussed in this chapter highlight the complexity of developing the FPTI methodology. Many of the problems will not be solved until attempts are made to develop operating systems, however. The methods employed to illustrate the development of such a system are described in the next three chapters.

SECTION II:

ESTABLISHING THE HUMAN ORGANIZATION-PERFORMANCE RELATIONSHIP: PHASE ONE

Phase 1 activities of the FPTI research focus on the nature of the relationship between the human organization and organizational effectiveness. Knowledge of this relationship is necessary before value attribution can be accomplished.

The three chapters in Section II (Chapters 4 to 6) describe the data and statistical methods used to investigate the human organization-performance relationship, and the results of these analyses. Chapter 4 addresses the question: Are there relationships between the human organization and organizational performance? Subsequent analyses required the existence of statistically significant relationships which were, in fact, found.

In Chapter 5 the prediction equations to be used in Phase 2 are derived, based on Time 1 measurement of the human organization and several measurements of organizational performance. Several assumptions underlying the predictive model (such as linearity of the data and the number of predictors required) are also investigated.

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In Chapter 6, the work groups to be included in the value attribution phase are selected. Issues, such as how to handle missing data and extreme "performance" scores, are addressed.

Thus, the products of these analyses are (1) equations for predicting performance changes at each of several times in the future and (2) definition of the sample of work groups for which these predictions will be made.

CHAPTER 4

THE HUMAN ORGANIZATION ⟶ PERFORMANCE RELATIONSHIP

This chapter focuses on the question: Are there significant relationships between the human organization and organizational effectiveness? Establishing the existence of relationships is a pre-condition for further development of the current value HRA methodology. The data sources, measures, and analyses are described below.

Data Sources

Between 1966 and 1970 data on organizational functioning and performance were collected from several industrial organizations as part of the Michigan Inter-Company Longitudinal Study (ICLS).* Out of six potentially useful data sets from this study, five met the criteria necessary for inclusion in the present research:

.. at least two collections of comparable human organization data with measures of sufficient reliability;

. organizational performance measurements across time with each performance period displaying sufficient internal consistency;

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*The objectives, procedures, and results of ICLS have been described by Likert, et al. (1969) and Bowers (1971; 1973).

- relationships between organizational functioning and performance measures which were not distorted (i.e., directionally inappropriate or very low in magnitude) due to such factors as wild variation in performance scores across time.

Data meeting these criteria were available from a polyvinyl chloride plant (Organization I), two assembly plants of a large, multi-location manufacturing company (Organization IV), a large oil refinery (Organization III), an aluminum extrusion mill (Organization IV), and three paper and cellophane mills of another multi-location company (Organization VI).

Measures of Organizational Functioning

ICLS was begun in order to make feasible the systematic investigation of relationships between the human organization and performance levels of organizational units. The Survey of Organizations questionnaire (SOO), a machine-scored, standardized instrument was developed as an integral part of this program. The questionnaire was needed to collect comparable data from diverse organizational sites. The first version of the SOO was completed in 1966. While modifications have since been made, most of the "core" measures remained consistent across the ICLS sites.

In its current edition, the SOO includes 124 items focusing on various aspects of the work setting. Six items focus on individual demographic characteristics. Thirty-seven additional spaces are provided for supplementary questions tailored to a particular organization or study. Responses to most items regarding the work

setting are recorded on a five-point extent scale ranging from (1) "to a very little extent" to (5) "to a very great extent." A description of the instrument together with statistical information regarding the validity and reliability of its component elements is provided by Taylor and Bowers (1972) in the questionnaire manual.

Four key dimensions of organizational functioning were measured by the SOO: Organizational Climate, Supervisory Leadership, Peer Leadership, and Satisfaction.* *Organizational Climate* refers to the organization-wide conditions, policies, and practices within which each work group operates. These conditions and practices are created for a work group by other groups, especially those above it in the organizational hierarchy. Climate conditions set bounds on what does and can go on within any work group. Aspects of climate can help or hinder conditions within groups.

Supervisory Leadership comprises interpersonal and task-related behaviors by supervisors as viewed by their subordinates. *Peer Leadership* comprises interpersonal and task-related behaviors by work group members toward each other. *Satisfaction* measures whether group members are satisfied with economic and related rewards, the immediate supervisor, the organization as a system, the job as a whole, compatibility with fellow work group members, and present and future progress within the organization.

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*Two additional dimensions -- Group Process and Goal Integration -- are currently measured by the SOO. However, these measures were not available for all the organizational sites in the present sample and were therefore excluded from all analyses.

In its current version, 15 major indexes from the SOO measure these four dimensions of organizational functioning. In the present research, two climate indexes (Technological Readiness & Lower Level Influence) were eliminated due to unsatisfactory reliability (alpha) coefficients displayed in Organizations I through IV. Thus, 13 key SOO indexes were the measures of organizational functioning. Brief descriptions of these indexes are provided in Table 1.

The SOO was administered at least twice to the five organizations. The time between survey administrations was about 12 months. The reliability (i.e., internal consistency) of the survey indexes was quite high (See Appendix A).

Measures of Organizational Performance

Two measures of performance were included in the data file:

1. Total Variable Expense (TVE). A measure of productivity defined by the ratio of actual performance to scheduled or standard performance.
2. Absenteeism (ABS). A measure of total absence defined by a ratio of observed absence to scheduled work days.

Monthly TVE and ABS measures were available for two different subsets of the five organizations (See Table B-1 in Appendix B for definitions of the measures in each site.)

Imputation. In order to relate the human organization to performance both variables must be measured at the same level of aggregation. In this study, performance (both TVE & ABS) was measured at the cost center level, where a cost center was the

Table 1

CRITICAL INDEXES

OF THE SURVEY OF ORGANIZATIONS

Organizational Climate

Decision Making Practices -- the manner in which decisions are made in the system: whether they are made effectively, made at the right level, and based upon all of the available information.

Communication Flow -- the extent to which information flows freely in all directions (upward, downward, and laterally) through the organization.

Motivational Conditions -- the extent to which conditions (people, policies, and procedures) in the organization encourage or discourage effective work.

Human Resources Primacy -- the extent to which the climate, as reflected in the organization's practices, is one which asserts that people are among the organization's most important assets.

Supervisory Leadership

Supervisory Support -- the behavior of a supervisor toward a subordinate which serves to increase the subordinate's feeling of personal worth.

Supervisory Work Facilitation -- behavior on the part of supervisors which removes obstacles which hinder successful task completion, or positively, which provides the means necessary for successful performance.

Supervisory Goal Emphasis -- behavior which generates enthusiasm (not pressure) for achieving excellent performance levels.

Supervisory Team Building -- behavior which encourages subordinates to develop mutually satisfying interpersonal relationships.

Peer Leadership

Peer Support -- behavior of subordinates, directed toward one another, which enhances each member's feeling of personal worth.

Peer Work Facilitation -- behavior which removes roadblocks to doing a good job.

Peer Goal Emphasis -- behavior on the part of subordinates which stimulates enthusiasm for doing a good job.

Peer Team Building -- behavior of subordinates toward one another which encourages the development of close, cooperative working relationships.

Satisfaction -- a measure of general satisfaction made up of items tapping satisfaction with pay, with the supervisor, with co-workers (peers), with the organization, with advancement opportunities, and with the job itself.

smallest unit for which production cost and absence figures were provided. Each cost center included at least one, and usually several, work groups. Human organization characteristics (13 SOO indexes) were measured at the work group level. Thus, either the average of the work group SOO scores had to be assigned to the appropriate cost center, or cost center performance scores has to be assigned (i.e., imputed) to all component work groups. Performing analyses at the cost center level was not feasible because this would have reduced the number of cases below the number required for the analyses. For this reason, the latter alternative, imputation, was chosen. Imputation provided a large N, equal to the number of work groups, for analysis. However, it also reduced performance variance by creating an artificially large number of identical scores. Thus, it placed a conservative limit on the size of the observed SOO-performance relationship.

Performance periods. It was desirable that the performance measures not reflect minor month-to-month fluctuation while still being capable of showing significant changes. The decision was made to group consecutive months into periods to maximize the consistency of the performance measure within each period.

A non-metric technique called Smallest Space Analysis (SSA) was used to determine the performance months to be included in each performance period for each organization. SSA takes as input measures of similarity or dissimilarity among some set of variables. The measure of similarity used in the present study was the Pearson product-moment correlation coeficient. Implications of defining performance periods using this measure are discussed as a utilization issue in Chapter 9.

A work group's performance score for a period was the average of its scores for the months composing that period. Both the performance periods and months were labeled in terms of their distance from the SOO administration. For example, the third month after the first SOO administration was month T_0+3. Periods were roughly comparable across organizations with regard to time since the SOO administration. Almost all periods included six or fewer months. The periods were labeled alphabetically. Some longer periods were assigned two labels so as to maintain more similar labels across organizations. A summary of the months included in each performance period by organization (Tables B-2 & B-3) and measures of the internal consistency of the periods (Table B-4) is presented in Appendix B.

Table 2 shows the organizations that provided TVE and ABS data for each period. As the Table shows, absence data were available from at least three organizations for Periods B through H. For Periods A, I, and J, there were data from only one organization. Nevertheless, the absence data were quite complete through period H.

TVE data were available from at least two organizations for Periods A, C-E, and I. For all remaining periods, only Organization VI provided TVE data.

Table 2

NUMBER OF CASES WITH PERFORMANCE DATA BY PERIOD AND ORGANIZATION

TVE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
ORGANIZATION II	61	--	61	61	61	--	--	--	--	--	--	--	--	--	--	--	--	--	--
III	--	--	254	254	254	--	--	--	248	--	--	--	--	--	--	--	--	--	--
IV	--	--	--	67	--	67	--	--	--	--	--	--	--	--	--	--	--	--	--
VI	127	127	127	127	127	131	51	51	161	124	51	51	186	79	79	79	49	108	108
Total	188	127	442	509	442	198	51	51	409	124	51	51	186	79	79	79	49	108	108

ABS	A	B	C	D	E	F	G	H	I	J
ORGANIZATION I	--	21	21	21	21	21	21	18	18	18
II	--	--	46	107	46	76	61	24	--	--
III	254	254	254	--	254	254	254	248	248	248
VI	--	114	114	--	114	--	--	--	--	--
Total	254	389	435	128	435	351	336	290	266	266

ANALYSES

Two research questions were the main focus of analyses reported in this section:

(1) Is there a multivariate relationship between the human organization and performance that is stable across sub-samples of a given population?

(2) How strong is the relationship and what is the time lag between human organization characteristics and their maximum impact on the organization's performance?

To test the first question, the entire array of work groups was split into two random sub-samples. Multiple regressions were performed on each sub-sample and then the regressions were double cross-validated. More specifically, performance measures for the organizations were converted to standard scores based on each organization's score distribution for a particular period. The separate organizational files were then merged. Thus, the data were combined to represent one hypothetical organization. Next, the total sample of groups was split into two sub-samples by randomly assigning the groups. Each sub-sample was submitted to multiple regression procedures which predicted performance from survey scores. The regression weights derived from each sub-sample were applied to the other sub-sample, the performance scores again predicted, and these second predictions correlated with the original performance scores. This procedure, "double cross-validation," was performed for each performance period and served as a rigorous test of the generalizability and stability of the observed relationships.

The second step was to examine the strength of the relationships across time. To do this, multiple regressions were performed

for each performance period using the entire sample. The same set of analyses was performed using each wave of SOO data.

Stability and Generalizability of the Human Organization-Performance Relationship

The double cross-validation procedure described above was applied using the SOO indexes as predictors of (1) total variable expense and (2) absence. Analyses were conducted for each of the two waves of SOO data. The multiple regressions and cross-validation statistics for the two random sub-samples are reported in Appendix C (Tables C-1 to C-4). Periods A through J were cross-validated for ABS. In the cases of TVE, however, Periods G, H, and J to S included data only from Organization VI. Therefore, the cross-validation procedures were not applied in these periods.

Wave 1 SOO Data. The results were encouraging for both performance measures. First of all, a number of the sub-sample regression coefficients were moderately high and statistically significant: the coefficients for TVE ranged from .24 to .78 and 50% (seven out of 14) of them were significant beyond the .05 level (See Table C-1). For 86% (six out of seven) of the TVE performance periods tested, at least one sub-sample produced a statistically significant regression coefficient. The cross-validation correlations for both sub-samples reached acceptable levels ($p<.07$) for 71% of the TVE periods tested (i.e., for all periods except F & I).

The coefficients for ABS ranged from .23 to .58; 65% (13 out of 20) of these were significant beyond the .05 level (See Table C-2). For 80% (eight out of ten) of the ABS performance periods, at least one sub-sample regression coefficient was statistically significant ($p<.05$). The cross-validation correlations were

significant (p.<.01) for both sub-samples in 70% of the periods (i.e., for all periods except D, E, & F). In Period F, the correlation for one sub-sample reached significance (p<.01), but not the other (p<.10).

These results suggested that the human organization characteristics measured at Time 1 were significantly related to performance and that the obtained relationships were generalizable to other groups in the same population.

Wave 2 SOO Data. Parallel analyses were conducted to investigate the stability of the human organization-performance relationship using Wave 2 SOO data. That is Wave 2 SOO scores were correlated with Performance Periods A-S. The second administration of the SOO followed the first by about one year. Thus, periods A-G really represent historical conditions when correlated with Wave 2 SOO.

Tables C-3 and C-4 (in Appendix C) report the multiple regression and cross-validation statistics for TVE and ABS for two random sub-samples. The results were generally weaker (for TVE) than those obtained using Wave 1 SOO data. Few of the sub-sample regressions were statistically significant (p<.05): the sub-sample regression coefficients ranged from .23 to .56; 28% (four out of 14) were significant (See Table C-3). The cross-validation r's were significant only in Periods D and F.

The results for ABS were higher (& more often significant). The sub-sample regression coefficients ranged from .28 to .66; 65% (13 out of 20) of them were significant. For nine out of ten ABS performance periods at least one sub-sample regression coefficient

was statistically significant. The cross-validation correlations were significant for 60% (six out of ten) of the ABS performance periods. Thus, the results using Wave 2 SOO data as predictors of ABS were similar in magnitude to the results using Wave 1 SOO data.

Strength of the Human Organization-Performance Relationship

To assess the strength of the relationship between the SOO predictors and the performance measures (ABS & TVE), multiple regressions were performed for each performance period using the entire array of data. As before, the analyses were done for each wave of SOO data. The results are shown in Tables C-5 through C-8 (See Appendix C). With Wave 1 SOO data as predictors of TVE, the coefficients ranged from .27 to .70; 37% (seven out of 19) of them were significant. The significant regressions were concentrated in early periods where the number of cases in each period was higher. Since Periods G, H, and J to S included data only from Organization VI, the N's were substantially reduced in these later periods. The N's during these periods ranged from 56 to 159, as compared to N's ranging from 130 to 526 in the earlier periods. Since the N affects the size of the regression coefficient required to attain significance, this reduction in N was an important factor. Only 16% (three out of 19) of the TVE coefficients were significant using Wave 2 SOO data.

The absence data were more complete in terms of the number of work groups in each period. For Wave 1 SOO data, the coefficients

ranged from .20 to .53; 80% (eight out of ten) of the coefficients were statistically significant. For Wave 2 SOO data, the regression coefficients ranged from .28 to .59; 90% reached significance. Thus, the relationships were stronger (in terms of statistical significance) for absence than for total variable expense.

However, relationships also existed between the human organization and total variable expense in greater proportion than would be expected by chance.

Investigation of Time Lag

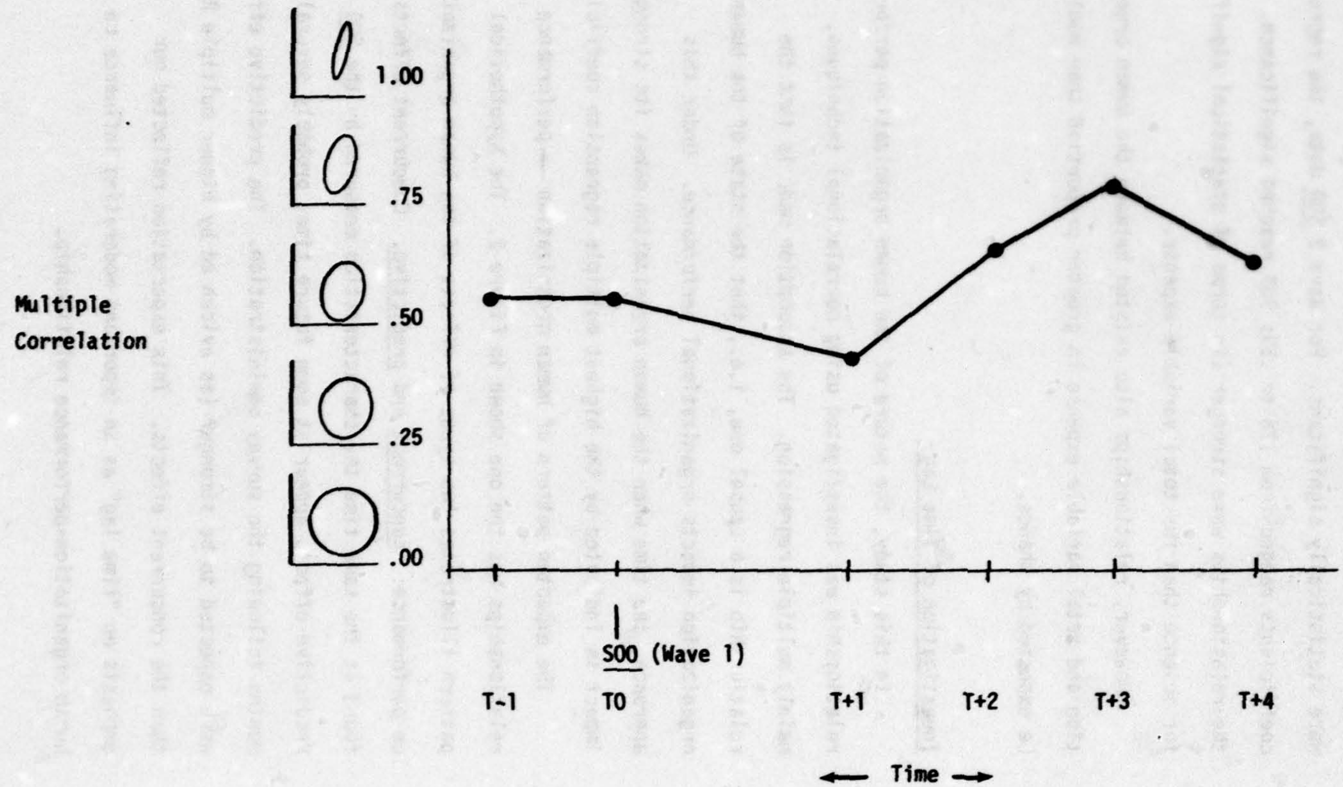
In this study, the nature of the human organization performance relationship was investigated using correlational techniques, mainly multiple regression. The assumption made is that the relationship is a causal one, i.e., that the state of the human organization impacts organizational performance. Under this approach, the time when the human organization makes its strongest impact is indicated by the highest multiple regression coefficient.

The expected pattern of human organization → performance relationships was the one shown in Figure 2. The hypothetical pattern illustrates two types of effects of the human organization on performance: concurrent and predictive. Concurrent effects are found at the same time the characteristics measured by the SOO exist. Predictive effects appear at some future time, probably several months following the survey administration. The predictive effects were expected to be stronger (as evidenced by higher multiple R's) than the concurrent effects. This expectation reflected our emphasis on "time lag" as an important moderating influence on the human organization-performance relationship.

Figure 2

Hypothetical Relationship Between

The Human Organization and Performance



As described before, separate regressions were computed for each performance period in order to investigate the pattern of relationships across time. Performance periods were defined for each organization, based on the inter-relationships of monthly performance across cost-centers (see pages 40-41). This method resulted, in several cases, in performance periods of different lengths across the five organizations. In order to investigate the time lag operating however, it was important that periods of equal length across all organizations be examined. Thus, five "spans" were defined which equalized the time periods covered across organizations.

The periods included in each span for both TVE and ABS are indicated in Tables 3 (Wave 1 SOO) and 4 (Wave 2 SOO).* Also shown are the mean multiple regression coefficients for the periods included in each span. The results are discussed below for each wave of SOO data.

The first survey administration took place between Spans 1 and 2. Since an earlier investigation (Taylor & Bowers, 1972) indicated that the survey scores reflect the work situation as it exists currently and up to six months prior to the survey measurement, Span 1 was considered to reflect concurrent effects of the human organization. Spans 2 to 5 showed predictive effects.

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*Some changes in span definitions were made for this final report as a result of a re-examination of the months included in each period for each organization.

The pattern of observed relationships followed the expected pattern quite closely for both absence and total variable expense (See Table 3). The concurrent effects, shown by the mean regression coefficients for Span 1, were moderate (Mean R = .39 for TVE, .37 for ABS). Predictive effects appear to have been strongest in Span 3 (Mean R = .48 for TVE, .46 for ABS). After Span 3, the average regression coefficients for TVE decline. Unfortunately, no absence data were available beyond Span 3. Also the mean coefficients for TVE in Spans 3 to 5 should be interpreted cautiously since several of the regression coefficients comprising these values were not statistically significant. As stated before, data for Spans 4 and 5 came only from Organization VI.

In spite of these limitations however, the results were very similar for TVE and ABS in terms of the both magnitude and the pattern of coefficients. The indication is that the time lag (between the state of the human organization and its strongest impact on performance) was approximately nine to 18 months. Due to the nature of the performance periods in the present study, the exact point (i.e., month) of maximum impact can not be identified.

Wave 2 SOO data. The second survey administration took place during Span 3. Thus, Spans 2a and 3 were considered to reflect concurrent effects. Spans 4 and 5 showed predictive effects. Span 1 and 2 showed relationships resulting from the effects of social system properties that existed the previous year.

The mean regression coefficients for each span are shown in Table 4. The results for TVE are difficult to interpret in this case,

Table 3

MULTIPLE REGRESSION STATISTICS ACROSS SEVERAL TIME SPANS (WAVE 1 SOO)*

	Span 1 Months 1-8 before SOO Wave 1 (Periods A, B, C)	Span 2 Months 0-8 after SOO Wave 1 (Periods D, E, F)	Span 3 Months 9-15 after SOO Wave 1 (Periods G-L)	Span 4 Months 16-24 after SOO Wave 1 (Periods M-L)	Span 5 Months 25-28 after SOO Wave 1 (Periods R, S)
TVE					
Entire Sample					
Mean R	.39†	.31	.48†		
Control Org. (VI)					
Mean R	.34	.35†	.49†	.42†	.32†

	Span 1 Months 1-6 before SOO Wave 1 (Periods A, B, C)	Span 2 Months 0-4 after SOO Wave 1 (Periods D, E)	Span 2a Months 5-8 after SOO Wave 1 (Periods F, G)	Span 3 Months 9-18 after SOO Wave 1 (Periods H-J)
ABS				
Entire Sample				
Mean R	.37	.27†	.33	.46

*For TVE, the mean R's for Organization VI alone were also computed because data for TVE periods G-H and J-S were available only from Organization VI, while several organizations (including Organization VI) provided data for Periods A-F and I. For Periods J-S to be representative of the larger sample of organizations the mean R's for the earlier periods for Organization VI should correspond to the mean R's for the total sample for those same periods. The results indicate that Organization VI's data were representative.

†This mean coefficient included at least one performance period R that did not reach statistical significance ($p<.05$). To examine the results by performance period, refer to Tables C-5 and C-6 in Appendix C.

Table 4

MULTIPLE REGRESSION STATISTICS ACROSS SEVERAL TIME SPANS (WAVE 2 SOO)*

	Span 1 Months 13-20 before SOO Wave 2 (Periods A, B, C)	Span 2 Months 4-12 before SOO Wave 2 (Periods D, E, F)	Span 3 Months 3-0 before & 1-3 after SOO Wave 2 (Periods G-L)	Span 4 Months 4-12 after SOO Wave 2 (Periods M-Q)	Span 5 Months 13-16 after SOO Wave 2 (Periods R, S)
TVE					
Entire Sample					
Mean R	.28†	.28†	.44†		
Control Org. (VI)					
Mean R	.35†	.36†	.48†	.43†	.38†

	Span 1 Months 12-18 before SOO Wave 2 (Periods A, B, C)	Span 2 Months 8-11 before SOO Wave 2 (Periods D, E)	Span 2a Months 4-7 before SOO Wave 2 (Periods F, G)	Span 3 Months 3-0 before & 1-3 after SOO Wave 2 (Periods H-J)
ABS				
Entire Sample				
Mean R	.44	.36†	.30	.40

*The mean R's for Organization VI only were computed for the TVE periods to investigate representativeness of coefficients in Spans 4 and 5 for which only Organization VI provided data. Organization VI's results were similar to results for the total Wave 2 sample, indicating representativeness of the R's.

†This mean coefficient included at least one performance period R that was not statistically significant ($p<.05$). To examine the results by performance period, refer to Tables C-7 and C-8 in Appendix C.

because so few (only 16%) of the performance period R's were significant originally. The results for absence are stronger although they are not exactly what was expected. The regression coefficients for Spans 1 and 2 (measuring absence rates occurring before the SOO measurement) were as strong or stronger than the results for Spans 2a and 3 (measuring absence rates occurring concurrently with the SOO measurement). Absence data did not extend far enough to see predictive effects, using Wave 2 SOO data. Possible interpretations of this unexpected finding are offered in the next section.

Comparisons Between Results for Wave 1 and 2 SOO Data

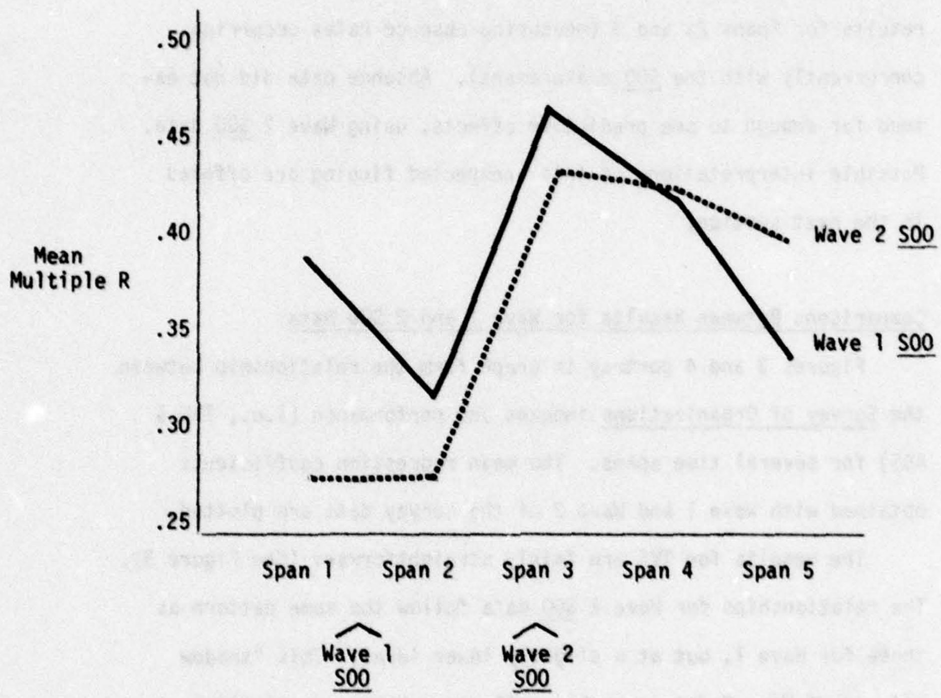
Figures 3 and 4 portray in graph form the relationship between the Survey of Organizations indexes and performance (i.e., TVE & ABS) for several time spans. The mean regression coefficients obtained with Wave 1 and Wave 2 of the survey data are plotted.

The results for TVE are fairly straightforward (See Figure 3). The relationships for Wave 2 SOO data follow the same pattern as those for Wave 1, but at a slightly lower level. This "shadow effect" of Wave 2 data probably reflects a human organization measured by Wave 2 SOO data which was similar to that in the Wave 1 data. Similar SOO scores would result in similar multiple correlation coefficients. Weaker relationships were expected with Wave 2 SOO data, especially in earlier Spans. This would indicate that the human organization was affecting performance, and not the other way around.

Figure 3

Relationships Between SOO and TVE across Time:

Comparisons Between SAO Waves 1 and 2



The results for absence were different (See Figure 4). In Spans 2a and 3, the human organization-performance relationships were stronger for Wave 1 than Wave 2 SOO scores. This was expected. However, for Spans 1 and 2, the mean regression coefficients were higher with Wave 2 SOO data as predictors than with Wave 1 data. This pattern of relationships suggested "reverse causation;" that is, that the state of the human organization was in part the result of (i.e., a response to) the absence rate in previous months, as well as the cause of the absence rate in subsequent months.

SUMMARY

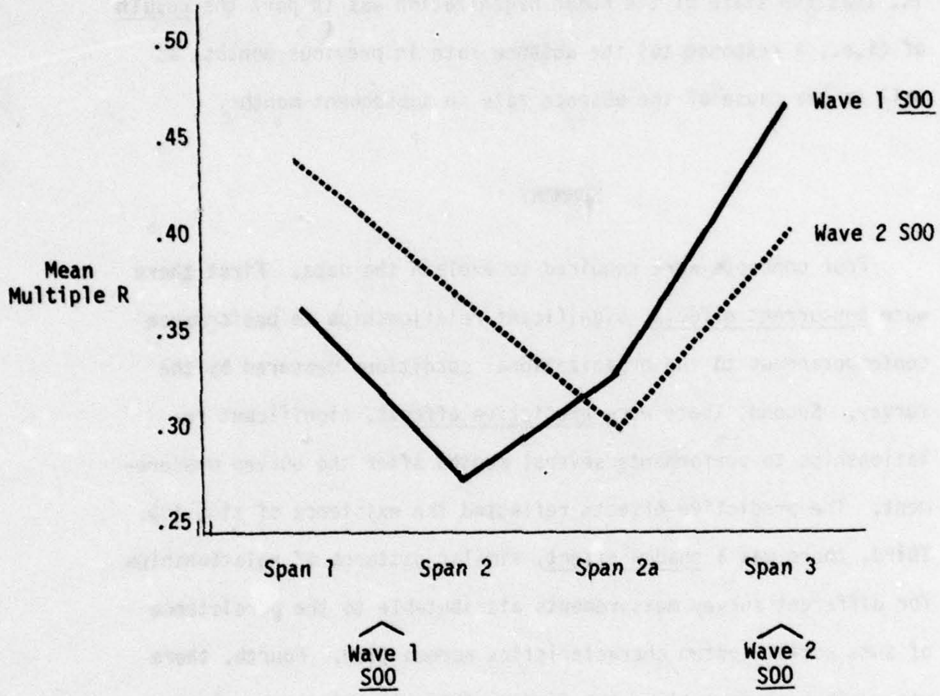
Four concepts were required to explain the data. First there were concurrent effects, significant relationships to performance contemporaneous to the organizational conditions measured by the survey. Second, there were predictive effects, significant relationships to performance several months after the survey measurement. The predictive effects reflected the existence of time lag. Third, there was a shadow effect, similar patterns of relationships for different survey measurements attributable to the persistence of some social system characteristics across time. Fourth, there was reciprocal causation, the finding that, in this case, absence, may be a cause as well as an effect of organizational conditions.

The shortcomings of the present analyses centered around the absolute magnitude of the obtained coefficients. They explained no more than 25 percent of the variance in performance among cost centers. Several facets of our procedure such as imputation and

Figure 4

Relationships Between SOO and ABS across Time:

Comparisons Between SOO Waves 1 and 2



standardization of performance scores removed or excluded potentially relevant criterion variance. A much higher portion of performance variance would be accounted for if those additional portions were included in our criterion measures.

In this context, the pattern of obtained relationships was reassuring. Statistically significant relationships were obtained in proportions far outweighing chance. Using Wave 1 survey data to predict total variable expense, coefficients were obtained which range from .27 to .70. Similar predictions to absence rate yielded a range of coefficients from .20 to .53. Predictions using Wave 2 survey data produced equally strong coefficients for absence, but weaker ones for TVE.

Lag time estimates both confirmed and expanded our expectations. While the differences between coefficients were not tested for statistical significance, the rise and fall in obtained relationships were similar to those depicted in the hypothetical example. The highest coefficients appeared nine to 18 months after the SOO Wave 1 measurement for both performance measures.

On the basis of the findings therefore, three basic requirements for constructing future performance trend indicators -- a current value approach to human resources accounting -- have been met:

1. Key dimensions of the human organization have been identified and accurate measurements obtained.
2. Reliable, valid indicators of organizational effectiveness have been obtained and refined.
3. Relationships between key dimensions of the human organization and performance have been established.

CHAPTER 5

DEVELOPMENT OF THE FUTURE PERFORMANCE TREND INDICATORS

Forecasting performance requires a statistical model for calculating the amount and timing of performance changes. The present model is based on the human organization-performance relationship and observed change in organizational conditions. In this chapter, the adequacy of the FPTI model is investigated and the equations for predicting performance changes are derived.

The human organization-performance relationship was described in Chapter 4. The predictor variables were measured at one point in time (T_0) and the criterion variables at several subsequent points in time (T_0+1, $T_0+2, \ldots, T_0+k$). The predictor and criterion variables were correlated using linear multiple regression. A separate regression for each value of k (months since the predictors were measured) was performed to take account of time lag. Organizational conditions were then measured at some time subsequent to T_0, say T_0'. In the present model the organizational conditions at T_0 and T_0' are used to predict the performance at times $T_0'+k$.

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Multivariate Model

Likert (1973) presented the statistical methodology for relating a single measure of the human organization to a measure of organizational effectiveness. Briefly, this consisted of (1) computing the Pearson product moment correlation between the measures, (2) converting both to standard scores, (3) multiplying the standard score change in the predictor measure by the correlation coefficient, which provided the predicted standard score change in the cost measure. This change was then converted to raw score form by multiplying it by the standard deviation of the criterion scores.

In the case where performance is related to one predictor at a time, as in Likert's (1973) univariate case, standard scores make the strength of the predictor-criterion relationship more evident. This is because the regression weight for the predictor equals the correlation between the predictor and the criterion. In a multivariate situation, however, conversion to standard scores does not generally have this advantage.* Because of the data used in this study, standardizing was necessary, but this may not always be the case. This issue is discussed further in the next section.

The multivariate methodology follows directly from the univariate case. Assuming that all variables and parameters represent their multivariate (matrix) counterparts we have the mathematical formulas shown in Table 5.

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*In the multivariate case, the regression weight for each predictor does not equal the correlation coefficient unless all predictors are orthogonal (Gordon, 1968; Linn, Werts, & Tucker, 1971).

Table 5

MATHEMATICAL FORMULA FOR

FORECASTING PERFORMANCE CHANGES

X	=	human organization predictor score at time 1
X'	=	human organization predictor score at time 2
Y	=	actual criterion score at time 1
$\hat{Y}$	=	predicted Y score
B_o	=	regression constant
B_1	=	regression weight for X
$\Delta\hat{Y}$	=	predicted change in performance

$$\hat{Y} = B_o + BX \tag{1}$$

$$\Delta\hat{Y} = \hat{Y}' - \hat{Y} = B_o' + B'X' - (B_o + BX) \tag{2}$$

Assuming $B' = B$ and $B_o' = B_o$ then:

$$\Delta\hat{Y} = B(X' - X) = B\Delta X \tag{3}$$

Equation (1) gives the estimated value of Y based on the linear relationship between Y and X. Equation (2) computes the predicted change in performance. The assumptions $B'B$ and $B_0'=B_0$ require that the predictor criterion relationship be the same at T_0+k as it is at $T_0'+k$. If the relationship is not the same, "variation" across predictor measurements has occurred. The problems resulting from such variation were discussed in Chapter 3. Basically, however, this assumption would invalidate the original predictor equations.

Equation (3) states that the predicted change in the criterion ($\Delta\hat{Y}$) equals the regression weight (B) multiplied by the change in predictor (ΔX), for all predictors.*

Requirements of the Multivariate Model

In order to apply the multivariate model, three requirements had to be met. First, data from five organizations were combined and thus measures of the predictors and criteria had to be comparable across organizations. Second, it was necessary that the data be linear. Third, it was necessary that the error terms be normally distributed.**

Criterion Standardization. The TVE and ABS measures for each organization have been described in Appendix B. The measures are very similar across the organizations. However, the different bases from which the measures were constructed indicate that they were not directly

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*ΔX is a *change score*, the difference between two measurements of the same attribute taken at different points in time. For a discussion of the issues and problems surrounding change scores, see Appendix D.

**While a normal distribution of error terms is not necessary for fitting the model, most of the classical techniques for testing hypotheses related to the model depend on the accuracy of this assumption.

comparable (e.g., for TVE the base was budgeted man hours for Organization II versus total scheduled work days for Organization III). In order to combine the cross-organizational data, therefore, each organization's scores were standardized. This transformed the raw scores to "z scores" and eliminated the measurement units. It also gave all the measures equal means ($\bar{z}$=0) and standard deviations (SD=1). After this transformation, called standardization, the data for the five organizations could be merged.

The calculation of the human organization-performance relationship described in Chapter 4 standardized each organization's data within each performance period. Standardizing *within* assumes that score distributions are different across performance periods. Where the performance scores of two periods are actually part of the same distribution, standardization within provides results identical to standardization *across* those periods, except for the effects of sampling error on the mean and the standard deviations. Thus, standardization within was chosen as more appropriate for the cross-validation procedures (Pecorella & Bowers, 1977).

However, computation of the current value of future performance (i.e., value attribution) requires that predicted changes in performance made in standard scores be reconverted to raw scores. If the scores are standardized within periods, a different transformation is required for each period-organization cell. No transformation is possible for period-organization cells with missing data. There were 30 such period-organization cells in our data.

Standardization *across* periods results in a single transformation for each organization. Thus, predicted standard scores can be converted to predicted raw scores regardless of whether data was originally available for a given cell. The problem of missing data necessitated standardization of criterion data across periods for the value attribution phase. Thus, the performance data were re-standardized across performance periods. The shift in standardization scheme changed the multiple R's because more than one organization's data were merged. (See Davenport, et al., 1977, pp. 20-25 for a detailed discussion). Table 6 shows, that in the present study, standardizing across periods produced slightly higher R's.

In conclusion, it should be noted that the entire standardization issue is more an artifact of combining data from different organizations in this study than it is a feature of the FPTI method itself. The analog of TVE for any single organization might be comparable across organizational units. If the measures varied across units, standardizing within each performance period would be preferable unless, as in the present study, situational constraints preclude it.

Linearity. The multivariate model used to predict performance changes assumes linearity. The linearity of the data have been tested by three procedures: eta^2 (Pecorella & Bowers, 1977), plots of the residuals versus predicted values, and plots of the residuals against each of the 13 <u>SOO</u> indexes (Davenport et al., 1977). All three procedures supported our assumption of linearity.

Table 6

EFFECT OF CRITERION STANDARDIZATION ON MULTIPLE R

TVE

	A	B	C	D	E	F	G	H	I
N	188	127	442	509	442	198	51	51	409
R_w	.46	.38	.34	.27	.27	.40	.57	.49	.26
P	.01	.16	.01	.01	.01	.01	.23	.58	.01
R_a	.51	.34	.39	.25	.27	.52	.57	.49	.28
P	.01	.35	.01	.01	.01	.01	.23	.58	.01

ABS

	A	B	C	D	E	F	G	H	I	J
N	254	389	435	128	435	351	336	290	266	266
R_w	.47	.30	.33	.34	.20	.32	.33	.43	.53	.43
P	.01	.01	.01	.33	.18	.01	.01	.01	.01	.01
R_a	.47	.48	.28	.39	.26	.33	.34	.35	.56	.45
P	.01	.01	.01	.10	.01	.01	.01	.01	.01	.01

R_w = Multiple R for equations with criterion standardized within periods.

R_a = Multiple R for equations with criterion standardized across periods.

p = Probability of obtaining this Multiple R by chance.

Error Distribution. The distributions of the error terms were investigated by graphing the frequency distributions of the residuals. A selected group of histograms, presented in Appendix E, suggested that the error terms were normally distributed. (For the complete set of histograms, see Davenport et al., 1977.)

Characteristics of the Model

Having chosen the statistical methodology and found no violations of the requisite assumptions, the variables and scores to be included in the prediction equations were selected. Three issues were relevant. First, should all 13 SOO indexes be included as predictors? Second, were there variables not part of the human organization (e.g., organizational size) that would improve predictions of performance if included as moderating variables in the equations? Third, should scores that were deviant from the bulk of the data be retained or eliminated?

Predictor Variables. There are three categories of organizational variables that could potentially be used to predict performance: (1) human organization characteristics measured by the SOO; (2) human organization characteristics not measured by the SOO, such as reward systems, job design, and structure; and (3) other variables descriptive of the organization that are not part of the human organization, such as size and technology. Future Performance Trend Indicator equations should include only human organization predictors. An organization might want to use predictors from category (2) above. As long as these measures are valid and reliable and affect the organization's effectiveness,

they can be used in current value HRA. The goal when developing an accounting system of this kind is to select the set of human organization variables that predict performance best. The number of predictors in the equation affects the N and multiple R required for statistical significance, however. The predictors included also affect the accuracy of the multiple R and of the B weight, if the significant predictors are multi-collinear with non-significant ones. Therefore, variables that do not add predictive strength should not be included.

The possibility of using a subset of the 13 SOO predictor variables in this study was explored using a backward regression technique. The backward regression technique begins with all 13 predictor variables and then eliminates those with little or no predictive value. This elimination process continues until only variables with a predetermined level of predictive strength remain. If a predictor is continually omitted across performance periods, it would be omitted from the final model.

This technique was applied to a sample of performance periods covering the entire time span. There were no variables omitted in all instances, while all variables were eliminated at least once. Thus, there was insufficient evidence for removing any subset of variables from the model. Analyses in the future might show that the predictive power of the variables varies with time lag. For example, peer leadership indexes might predict performance best at Time 1 while climate indexes might predict best at Time 4. Further research is needed to investigate this possibility. For the present study, however, all 13 SOO indexes were included in the model (Davenport, et al., 1977).

Modifier Variables. It is possible that certain variables outside the causal model modify the relationship between the SOO indexes and performance. Organizational size and labor vs. capital intensiveness were two potential modifiers. Modifier variables can be included in the model by (1) computing separate FPTI equations for different values of the modifiers or by (2) including the modifiers as interaction variables in the model. Time lag was included as a modifier variable using the first method.

Inclusion of modifiers in the FPTI equations was beyond the intended scope of this study. For example, if size were included in the model, change in the organization's performance due to size (or the interaction of size and some SOO variable) would have to be partialed out (removed) so that predicted change would be attributed only to changes in the SOO indexes. The data available for these analyses do not meet the requirements for these procedures, especially in terms of the number of cases required.

Nevertheless, to explore potential modifiers, a series of regressions were performed to test the explanatory power of these two variables (Davenport, et al., 1977). Both size and capital intensity significantly improved predictions of performance. Which one added more to the model varied with the time lag and the organizations in a given period.

Outliers. When there are performance scores that deviate from the rest of the data set, a decision to retain or eliminate those scores must be made. Plots of the residuals revealed some extreme values (defined as values in excess of 3.5). No systematic variations, such as the same cost center over time, were found. Regressions were performed

including and excluding the outliers. As statistical theory predicts, the extreme values had strong leverage in fitting the regression model to the data and therefore, distorted the results. Since the deviant scores were thought to result from inaccuracy in reporting or recording the data, the outliers were subsequently removed from the analyses. Twenty scores were deleted whose scores exceeded 3.5 (see Davenport, et al., 1977).*

Deletion of outliers increased the relationship between the SOO and the criteria slightly (see Appendix F). To avoid further alteration the performance scores were not re-standardized after the data were deleted.

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*In all periods except ABS-D, only one cost center's score was eliminated. For ABS period D, two were deleted.

CONCLUSIONS

The result of these analyses is the FPTI equations for use in the value attribution phase. Table 7 summarizes the characteristics (N,R,p) of the FPTI equations. Tables 8 and 9 list the weights (B_o, B_1, B_2,...B_{13}) for TVE and ABS. These statistics will be used to predict changes in future performance. They express the predictive power of each SOO in the presence of the other indexes. Table 10 presents the number of work groups from each organization with SOO scores were available for two measurement times (T_o & T_o') and with performance scores (excluding outliers) available for at least one performance period. Thus, the FPTI equations represented in Tables 8 and 9 will be applied to SOO change scores for the work groups in Table 10. The predicted changes in performance will then be converted to dollars and discounted to present value.

Table 7

VALUES OF N, R, AND p FOR THE REGRESSION EQUATIONS USED TO DEFINE FPTI'S

TVE

	A	B	C	D	E	F	G	H	I
N	188	127	442	505	442	198	51	45	409
R	.51	.34	.39	.28	.27	.52	.57	.57	.28
p	.01	.35	.01	.01	.01	.01	.23	.35	.01

ABS

	A	B	C	D	E	F	G	H	I	J
N	254	389	434	121	434	351	336	289	266	266
R	.47	.40	.31	.40	.30	.33	.34	.42	.56	.45
p	.01	.01	.01	.10	.01	.01	.01	.01	.01	.01

Table 8

BETA WEIGHTS FOR PREDICTING TOTAL VARIABLE EXPENSE

	TVE Performance Periods								
Predictors	A	B	C	D	E	F	G	H	I
Regression Constant	.00247	.16430	.49197	1.0669	.94343	-.83179	-.71201	.60534	.57522
Supervisory Support	-.18483	-.01911	-.17555	-.04021	-.02063	.24337	-.29418	-.29767	-.07030
Supervisory Goal Emphasis	.11443	.11000	.20353	.24248	.16684	.10592	-.12580	-.43941	.04352
Supervisory Work Facilitation	.11195	.12490	-.00630	-.06977	-.02334	.15926	.34966	.32313	.10334
Supervisory Team Building	.12577	-.21590	.02611	.00948	-.06070	-.48260	-.06603	.49962	-.10963
Peer Support	.39078	.03359	-.15249	-.09380	-.10912	.25140	.08940	.29487	-.08029
Peer Goal Emphasis	-.12371	.13237	-.24554	-.25009	-.11746	.42923	.15495	-.14403	-.31091
Peer Work Facilitation	-.43689	-.36955	-.05815	-.19456	-.12499	-.97722	-.04795	-.31268	-.19232
Peer Interaction Facilitation	-.09009	.18499	.44040	.38398	.36051	.51046	-.19970	.13590	.57676
Human Resources Primacy	-.08535	-.09361	-.16294	-.16463	-.36935	.56292	.23469	-.01118	-.17215
Communication Flow	-.26790	-.18887	-.38943	-.48789	-.25253	.14878	.08824	.12399	-.15804
Motivational Conditions	-.12977	-.20126	-.01472	.22501	.19181	-.19849	.02421	-.37802	.08388
Decision Making Practices	-.35838	-.12199	.02672	.02686	.05695	-.90434	-.20198	.15358	.20576
Satisfaction	.62770	.40399	.33829	.03748	-.00535	-.03477	.15442	-.08274	-.07647

Table 9

BETA WEIGHTS FOR PREDICTING ABSENCE

Predictors	ABS Performance Periods A	B	C	D	E	F	G	H	I	J
Regression Constant	1.5179	.49961	1.0282	1.0352	.22473	1.0094	.67690	.45852	-1.0411	.30370
Supervisory Support	-.48979	-.09379	-.35387	-.12286	-.09911	.14929	-.21582	-.07133	.39141	-.22864
Supervisory Goal Emphasis	.04810	.18358	.12241	-.21631	.36472	.14842	.16558	-.07054	.05707	-.00076
Supervisory Work Facilitation	.15065	.05978	.18522	.27108	-.46797	-.11026	.01772	.13328	-.16584	.13054
Supervisory Team Building	.10312	-.20706	-.04771	.07458	.19924	-.06599	.11636	-.02617	-.20138	.08197
Peer Support	-.56715	.27172	-.17250	-.09903	.14298	.17288	-.06851	-.17588	.46732	-.20608
Peer Goal Emphasis	.06387	-.13370	-.27301	.02057	-.19864	-.01931	.24868	-.11328	.02489	.04345
Peer Work Facilitation	.18083	-.62019	-.25236	.18299	.30477	.16527	.28413	-.13064	-.12974	-.02875
Peer Interaction Faciliation	.52212	.44863	.44706	-.25277	-.27005	-.27351	-.15285	.50633	-.36227	.28559
Human Resources Primacy	-.28960	.03289	-.02992	-.16707	-.37616	-.12823	-.12451	-.18422	.01404	-.16442
Communication Flow	-.18017	.25347	.06572	.30429	-.10363	.02381	-.29979	-.11554	.41686	-.07937
Motivational Conditions	.12527	-.18171	-.24122	-.13253	.46093	.04377	.19541	-.09696	-.03654	.14282
Decision Making Practices	-.30246	-.22958	-.12186	-.08815	.44863	-.18535	-.32057	-.11913	.33242	-.10209
Satisfaction	.33982	-.16062	.32023	-.02681	-.26313	-.21633	.03280	.20076	-.62103	.01809

Table 10

WORK GROUPS WITH T_o AND T_o' SOO SCORES
AND PERFORMANCE DATA*

		TVE	ABS
Organization	I	--	27
	II	233	233
	III	176	176
	IV	115	--
	VI	246	197
	Total	770	633

*Outliers have been deleted.

CHAPTER 6

PREPARING FOR VALUE ATTRIBUTION

This chapter describes the steps necessary to illustrate the value attribution process and the final sample of work groups included in FPTI predictions. In Chapter 3 value attribution was described as a three-step process. Due to characteristics of the present data, however, the three steps were expanded to six:

(1) Compute predicted changes in effectiveness criteria (ABS & TVE).

(2) Convert predicted changes (in standard scores) to raw score form.

(3) Aggregate changes predicted for work groups to cost center level.

(4) Cost predicted cost center effectiveness changes and aggregate to the organizational level.

(5) Convert organizational cost changes predicted by performance period to changes predicted by month.

(6) Discount and capitalize predicted monthly cost changes for each organization.

Steps 1, 4, and 6 followed directly from the three-step value attribution process described in Chapter 3. Steps 2, 3, and 5 arose from the data used in the present study. However, to the extent other

data sets are similar to this one, amplification of the basic process will not be unique to this study.

Selection of Work Groups for Value Attribution

One of the requirements for value attribution is measurement of the human organization at two points in time. There were 797 work groups in the data set for which T_0 and T_0' SOO scores were available. A second requirement is knowledge of the relationship between the SOO scores and TVE and ABS. These relationships were computed for each criterion using two different subsets of five organizations (Organizations II, III, IV, & VI for TVE; Organizations I, II, III, & VI* for ABS). These relationships are represented by the B weights in Tables 8 and 9. Performance data were not available for all periods for the 797 work groups with SOO data.

There were several alternative methods for selecting work groups to be incuded in predictions. At one extreme, changes in TVE and ABS could be predicted for all 797 work groups with T_0 and T_0' SOO scores. This method would apply the equations to some work groups not included when developing the equations (i.e., to work groups with no performance data for one or more performance periods. Toward the other extreme, predictions could be made for only those work groups included in the calculation of each prediction equation (i.e., for groups with SOO & performance data for a given period). This was too conservative, since cross-validation of the human organization-performance relationships indicated these relationships to be generalizable to work groups from

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*Plant 1's absence data was excluded because of the high frequency of "reverse" correlations found for this plant in initial analyses (see Pecorella & Bowers, 1976). Plants 2 and 3 were included.

the same organizational "population" as those used to develop the relationships.

An intermediate alternative was chosen. Predictions were made for all work groups meeting the following criteria:

(1) Had T_0 and T_0' scores on 13 SOO indexes.

(2) Belonged to a cost center which had criterion data for the criterion being predicted, for at least one performance period of interest (TVE Periods C-I; ABS Periods C-J).

(3) Belonged to an organization represented by at least one cost center in one or more performance periods of interest.

Using these criteria, the number of work groups included in predictions remained constant across the performance periods of interest. Equal N's across periods were necessary for discounting and capitalization.

Using these criteria, predictions were made for all work groups with two waves of SOO data, and performance data for at least one period. Thus, predictions were sometimes made for groups even if they were from organizations not represented in a particular period. That is, predictions were made for some groups not represented in the organizational population used to develop the prediction equations. This was not desirable, but was made necessary by the limitations of the present data set. The actual number of groups from each organization, along with the number of respondents and cost centers represented by those work groups, are shown in Table 11.

Table 11

NUMBER OF WORK GROUPS, ASSOCIATED COST CENTERS AND WORK GROUP MEMBERS TO BE USED IN VALUE ATTRIBUTION, BY ORGANIZATION AND CRITERION

	TVE			ABS		
	Work Groups	Cost Centers	Individuals	Work Groups	Cost Centers	Individuals
ORG I	---	---	---	19	10	154
ORG II[1]	62	15	277	62	15	277
ORG III	162	11	1233	162	11	1233
ORG IV	104	14	1006	---	--	---
ORG VI[2]						
Plant 1	49	31	425	---	--	---
Plant 2	38	20	428	38	20	428
Plant 3	92	36	1132	92	36	1132
Total	507	127	4501	373	92	3244

[1]These 62 work groups come from all four plants in ORG II. Only two of the plants were used in calculation of TVE equations while all four were used in calculation of ABS equations. Predictions for all four plants will be made for both criteria because plants were similar enough to be treated as a single Organization (Pecorella & Bowers, 1976a).

[2]ORG VI consists of three plants which have been treated separately throughout the analyses. Thus, TVE would be predicted for all three plants which were used in the calculation of the TVE equations and the ABS will be predicted for the two plants (2 & 3) which were used in the calculation of ABS periods.

Lag Time, Months, and Periods

In addition to selecting the work groups for which predictions would be made, we had to determine the period of time over which future performance would be estimated. Since most organizations have an accounting cycle of one year, monthly performance was predicted for one year following the Wave 2 SOO data collection, i.e., through T_o' + 12 months.

As discussed previously, there is a change in the predictor-criterion relationship over time (Pecorella & Bowers, 1977), and this change has implications for the prediction of changes in the criteria (Davenport, et al., 1977). Specifically, a relationship between the SOO measured at T_o, and the effectiveness criterion measured k units of time later at T_o+k will be used to predict a change in the criterion. This change is predicted to occur at $T_o'+k$, i.e., k units of time after the second SOO measurement at T_o'. The parameter k represents time since the SOO measurement.

The time units in this research were periods and months (see Chapter 4). It is straightforward to define the month(s), $T_o'+k$, for which predictions are made using the relationship developed at T_o+k. However, when k is expressed in periods, it is not as clear when $T_o'+k$ occurs. We defined equivalent performance periods comparable to the original performance periods for which prediction equations were developed. Any such equivalent period was defined to include the same months relative to the second SOO administration (T_o') as the original period contained relative to the first SOO administration (T_o).

Figure 5 provides an example of this notion of equivalent periods. In Organization IV, TVE period D-E consisted of months T_o+0 through T_o+8; in Organization VI, Plant 3, TVE period D consisted of months T_o+0 through T_o+2; E contained T_o+3 through T_o+5 and F contained T_o+6 through T_o+8. These are shown in Figure 5a. The time periods for which we predicted TVE changes for each Organization subsequent to T_o were periods constructed to be equivalent to the time periods subsequent to T_o for which the equations were developed. Figure 5b shows these equivalent periods. For Organization IV, equivalent periods D and E contained months T_o'+0 through T_o'+8. Thus we used the prediction equations developed for periods D and E to predict for months T_o'+1 through T_o'+8 (we did not predict for T_o'+0) for Organization IV. In this case we applied period D's equation to T_o'+1 through T_o'+4 and period E's equation to T_o'+5 through T_o'+8. For Organization VI, plant 3, we used the period D equation to preidct for equivalent period D containing months T_o'+1 and T_o'+2. Period E and F equations were applied in a similar manner to predict for equivalent periods E and F. The situation where no organizational period was defined for certain months due to missing criterion data is dealt with in Step 5 where the month to period conversions are made. Thus, whenever we speak of predicted change for a given period, it is to be understood that the change is predicted for a period equivalent to the original performance period of the same name for a given organization.

Figure 5a

Relation of Performance Periods And Equivalent Periods

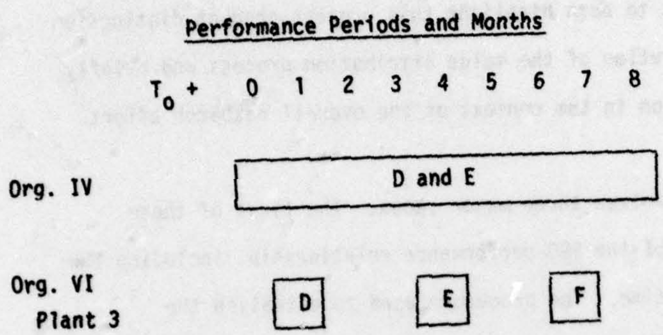
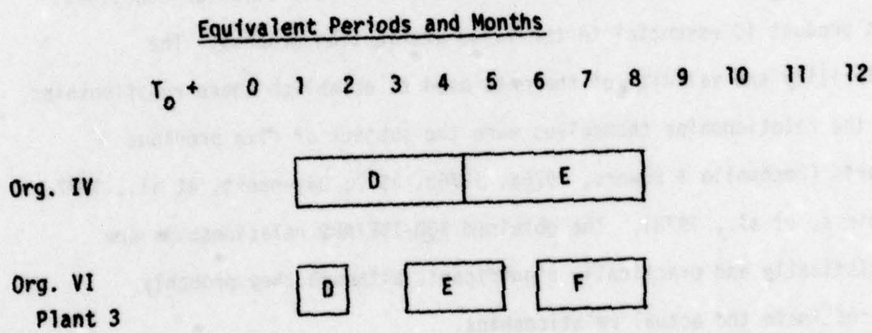


Figure 5b



Process and Product

In the preface we distinguished the primary concern of the present research, i.e., the development and demonstration of the value attribution methodology as an analytic process, from the secondary though still important concern with the products of that analytic process. At this point we want to both highlight this process-product distinction regarding the illustration of the value attribution process and briefly place this illustration in the context of the overall research effort thus far.

This research involves three major steps. The first of these is the establishment of the SOO-performance relationship, including the investigation of lag time. The procedure used to establish the relationship was double cross-validation of multiple regression results using two random sub-samples, followed by multiple regressions using the total sample. The product was the set of FPTI prediction equations. This product is essential to the value attribution process. The reliability and validity of the data used to establish these relationships and the relationships themselves were the subject of five previous reports (Pecorella & Bowers, 1976a, 1976b, 1977; Davenport, et al., 1977, Lapointe, et al., 1978). The obtained SOO-TVE/ABS relationships are statistically and practically significant, although they probably underestimate the actual relationships.

The second step is the prediction of change in effectiveness criteria. As previously indicated, this requires knowledge of the SOO-TVE/ABS relationship and evidence of change in the SOO scores (Davenport, et al., 1977), both of which we have. It also requires the

assumption that previously established SOO-ABS/TVE relationships will be valid in the future. Given this assumption (examined in Chapter 7) we can predict criterion changes. The accuracy of our predictions is influenced by the ability to predict (indicated by the value of R), the correctness of our assumptions, and the reliability of our predictor change scores.

The costing procedure followed by discounting and capitalization, yields the final product, i.e., the current dollar value of the predicted changes in the effectiveness criteria. This third step requires consideration of several aspects of the how the performance measures were constructed, as well as how the discounting and capitalization procedures should be applied to the predicted changes in costs. In this example, the data were available to illustrate completely the costing process. The accuracy of the final product -- the current investment values -- depends on having: (1) criteria which are defined in accordance with the requirements listed in Chapter 2, (2) the ability to determine costs to the organization of these criteria, and (3) knowledge of the timing of the future changes in effectiveness. This last is provided implicitly by our use of different prediction equations for different times since the SOO measurement. Because the data available for this research were not collected specifically for developing FPTI's, we do not possess all the information implied by items (1) and (2) above. We do, however, possess enough of this information to demonstrate the process by which this final product is obtained. Although the estimate of current value of changes in the human organization will not be as accurate as it would be in an actual FPTI implementation, it should be in the range one would expect. Thus, the inability to cost the predicted

criterion changes accurately does not detract from the demonstration of the process used to obtain that result. We now turn to an illustration of the value attribution process applying the six steps listed at the beginning of this chapter.

SECTION III

ILLUSTRATIONS OF CURRENT-VALUE HRA

Phase 2 of this study focuses on the three basic steps in value attribution: (1) the prediction of changes in performance, (2) the determination of the dollar value of these changes, and (3) the capitalization and discounting of these (future) dollar values to reflect their current value to the organization. The two chapters in Section III (Chapters 7 & 8) provide two case examples of current value human resources accounting.

In Chapter 7, the value attribution process is illustrated using extant data from business and industry. Despite certain limitations of the data, all three steps listed above could be illustrated.

In Chapter 8, the basis is laid for direct extension of the current value HRA methodology to Navy settings. The degree to which Navy data meets the basic requirements for HRA is assessed. A hypothetical example of value attribution using one Navy performance measure (total reenlistment) is also provided.

CHAPTER 7

VALUE ATTRIBUTION: A CASE EXAMPLE IN BUSINESS AND INDUSTRY

The definition, requirements, and benefits of value attribution have been discussed in previous chapters. All preliminary analyses were conducted on data from five civilian companies combined to form one hypothetical organization. The outcome was a set of equations for predicting changes in organizational performance attributable to a human organization which was better or worse at Time 2 (T_o') than at Time 1 (T_o).

This chapter summarizes an illustration of value attribution. It is the first application of FPTI which completes all three value attribution steps: (1) prediction of changes in effectiveness, (2) costing of these changes, (3) discounting and capitalizing of the cost changes to their present value. The end-result, shown in Table 20, is the capitalized dollar value of changes in the human organization.

As stated in Chapter 6, because of the nature of the available performance data, the three basic steps in value attribution were expanded to six. The results from each step are summarized below.

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FORECASTING PERFORMANCE IN ORGANIZATIONS: AN APPLICATION OF CUR--ETC(U)

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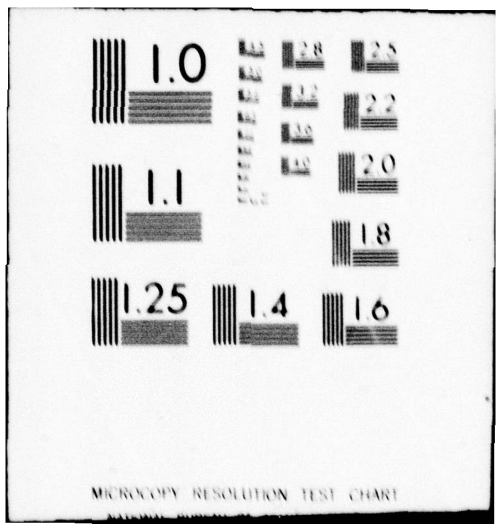
1.0
1.1
1.25
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1.6
1.8
2.0
2.2
2.5
2.8
MICROCOPY RESOLUTION TEST CHART

1. Prediction of Changes in Effectiveness Criteria

The relationship of the change in the human organization (ΔHO) to predicted change in performance ($\Delta\hat{P}$) is given by the equation $\Delta\hat{P} = B\Delta HO$. Values of ΔHO and the reliability of these change scores are shown in Appendix G. The B's for each performance period of interest were shown in Chapter 5 (pp. 72, 73). Application of the equation shown above using the B's in Chapter 5 and the ΔHO represented in Appendix G yielded a predicted change in TVE and ABS for each work group for each performance period. The means and standard deviations of these predicted changes are listed in Table 12. A negative quantity indicates predicted improvement in organizational performance.

2. Conversion of Predicted Changes to Raw Score Form

The regression weights (B's) were computed using performance data which had been standardized across periods and within each organization. The conversion to standard scores altered the magnitude of the regression weights, which in turn effected the predictions made using these weights. Thus, it was necessary to return the standard scores to raw score form. To do this, the inverse of the linear transformation originally applied was used. The transformation equations are shown in Appendix H. The outcome of the transformation was the predicted raw score changes. A description (mean & standard deviation) of these changes is given in Table 13.

Table 12

MEANS AND STANDARD DEVIATIONS OF

PREDICTED "STANDARD" SCORE CHANGES IN TVE AND ABS, BY PERIOD

		C	D	E	F	G	H	I	J
TVE	Mean	-.047	-.077	-.043	-.094	.016	.057	-.018	
(N=507)	SD	.286	.303	.261	.542	.217	.358	.253	
		C	D	E	F	G	H	I	J
ABS	Mean	-.013	.051	-.009	-.043	.001	-.001	-.016	.027
(N=373)	SD	.264	.225	.362	.229	.319	.260	.428	.220

N = number of work groups

Table 13

MEANS AND STANDARD DEVIATIONS OF

PREDICTED RAW SCORE CHANGES IN TVE AND ABS, BY PERIOD

		C	D	E	F	G	H	I	J
TVE	Mean	-.072	-.175	-.070	-.147	.067	.127	-.006	
(N=507)	SD	1.07	1.09	.892	1.90	.728	1.22	.928	
		C	D	E	F	G	H	I	J
ABS	Mean	-.053	.163	-.012	-.128	-.014	-.015	.009	.084
(N=373)	SD	.895	.785	1.28	.816	1.07	.870	1.43	.734

N = number of work groups

3. Aggregation to the Cost Center Level

There are two reasons for aggregating criterion changes predicted at the work group level to a more inclusive level. It may be computationally convenient for further steps in the value attribution process, or it may be necessary because of the nature of the measures. In the present analysis, it was required by the imputation of original cost center ABS and TVE scores to the work groups in that cost center. This was done to provide an adequate number of work groups for development of the prediction equations. The imputation resulted in the criteria and the predicted criterion changes being of a magnitude appropriate for a cost center. To avoid inflated predictions of performance changes and cost savings, the predicted work group changes were converted to cost center changes. The changes predicted for each work group were averaged across all work groups in a cost center and that average was assigned as the predicted change for the cost center. This was done in each period. The mean and standard deviation of the distribution of predicted cost center changes for each period are shown in Table 14.

4. Costing of Predicted Cost Center Changes and Aggregation to the Organizational Level

Using available data, we estimated the costs associated with various levels of ABS and TVE. These estimates were used to cost the predicted performance changes, thus providing an estimate of the magnitude of the cost changes and an illustration of the costing process. However, not all the data necessary to cost the predicted changes

Table 14

MEANS AND STANDARD DEVIATIONS OF PREDICTED RAW SCORE CHANGES IN TVE AND ABS AGGREGATED TO COST CENTER LEVEL, BY PERIOD

		C	D	E	F	G	H	I	J
TVE	Mean	-.065	-.138	-.070	-.168	.004	-.097	-.022	
(N=127)	SD	.455	.449	.402	.699	.235	.385	.310	
		C	D	E	F	G	H	I	J
ABS	Mean	-.101	.231	.039	-.114	.015	-.077	.002	.067
(N=92)	SD	.662	.565	.693	.580	.990	.727	1.256	.691

N = number of cost centers

accurately for each cost center were available. Therefore, following the illustration of Step 4, we will discuss some of the factors which probably influenced the costing process in this case. Similar influences would be in effect whenever the data are of the form used here.

TOTAL VARIABLE EXPENSE

TVE and its Relationship to Dollar Costs. The TVE measures from each organization were not identical (see Appendix B). However, the measures from Organizations II and III were quite similar and the measures from Organization IV and VI were virtually identical. The major difference between these two sets of TVE measures (II & III vs. IV & VI) was that the first two dealt with hourly labor costs while the second two dealt with all variable production costs. More importantly, all the TVE measures were a ratio of actual cost (due to labor or total costs) to budgeted cost (scheduled labor costs or total budgeted expense). Budgeted cost was the cost of performing the cost center's projected work if all work was accomplished according to engineered performance standards. For this illustration we treated the TVE measures from all four organizations as though they were a ratio of actual total costs to budgeted total costs. This resulted in a uniform, though simplified, costing procedure being applied. The effect of treating the labor-cost-based TVE measures from Organizations II and III as though they were total-cost-based measures is discussed in Appendix I.

The TVE measure used was in the form: $\frac{\text{Actual Dollars}}{\text{Standard Dollars}} \times 100 = \text{TVE\%}$. Step 2 above provided predicted changes (Δ) in TVE. Multiplication of the TVE score by the appropriate "standard dollars" for each cost center, and division by 100, would yield predicted change in "actual dollars," the desired outcome of Step 4.

Engineered dollar standards were available only for one plant from Organization VI. The standards were from all cost centers in that plant for 12 months between July 1967 and August 1968, the end of the period for which performance data were collected. The mean, standard deviation, and decile values of the cost center dollar standards are shown in Appendix J.

The same engineered standard was applied to every cost center. We chose representative -- i.e., low, medium, and high -- levels of the engineered dollar standards in order to provide a range of dollar estimates. More specifically, the engineered standards at the 25th, 50th, and 75th percentiles of the distribution ($20,887, $55,715, & $144,150) were used in computing the predicted change in "actual dollars."

The following computations provided the predicted dollar change associated with TVE for each organization:

(1) Multiplying each cost center's predicted TVE change score by the standard (see Table I-1 in Appendix J).

(2) Summing these products to the organizational level.

The result of these two computations was the predicted dollar change in TVE, at three levels of Standard, for each of the four organizations (see Table 15). Negative quantities indicated improved cost performance. This is true in subsequent tables for TVE and ABS.

Table 15

DOLLAR VALUE OF PREDICTED CHANGE IN TVE FOR EACH ORGANIZATION, BY PERIOD

		N	C	D	E	F	G	H	I
$ STANDARD = $20,887	ORG II	15	-668	-764	-190	710	269	1017	44
	ORG III	11	-447	-898	-349	73	40	-104	-205
	ORG IV	14	-806	-585	-464	-407	33	92	-267
	ORG VI - Plant 1	31	-96	-194	-102	-73	63	203	-33
	Plant 2	20	-173	-249	-169	-403	-17	31	-152
	Plant 3	36	474	-975	-593	-4357	-278	1328	23
		N	C	D	E	F	G	H	I
$ STANDARD = $55,715	ORG II	15	-1783	-2039	-507	1894	719	2713	117
	ORG III	11	-1192	-239	-930	195	106	-279	-546
	ORG IV	14	-2151	-1560	-1237	-1086	89	245	-713
	ORG VI - Plant 1	31	-256	-518	-273	-195	167	540	-89
	Plant 2	20	-462	-663	-451	-1075	-45	84	-407
	Plant 3	36	1265	-2609	-1582	-11622	-741	3543	61
		N	C	D	E	F	G	H	I
$ STANDARD = $144,150	ORG II	15	-4613	-5276	-1312	4901	1860	7020	303
	ORG III	11	-3085	-6198	-2407	505	274	-721	-1413
	ORG IV	14	-5564	-4036	-3200	-2811	231	634	-1845
	ORG VI - Plant 1	31	-663	-1341	-706	-505	432	1398	-231
	Plant 2	20	-1196	-1715	-1168	-2782	-115	259	-1052
	Plant 3	36	3272	-6732	-4094	-30070	-1917	9168	159

N = number of cost centers

Thus, although we used three different estimates of the standard to provide a range of dollar cost estimates, the standard in each example was constant across all cost centers. This would not be the case if each cost center's standard were available. The standard used in each example can be thought of as the average cost center standard for organizations with low, medium, and high (25th percentile, 50th percentile, & 75th percentile) standards.

ABSENCE

The ABS Criterion. The ABS measures from all four organizations took the general form: $\frac{\text{Number of Absences}}{\text{Possible Number of Absences}} \times 100 = \text{ABS\%}$. For TVE, we had divided by 100 and then costed the predicted change in TVE directly since the TVE measure was a ratio of dollar costs. However, for ABS, we divided by 100 to eliminate the percentage and then multiplied the predicted change in ABS by the denominator of the ABS measure. This provided a predicted change in the number of absences. This change was then costed using an estimate of the cost per absence.

Predicted Change in Person-days Absent. The ABS measures from Organizations I,* II, and III (see Appendix B) were computed as: $\frac{\text{Person-days Absent}}{\text{Person-days Scheduled}} \times 100 = \text{\% ABS}$. The ABS measure from Organization VI was computed as: $\frac{\text{People Absent}}{\text{People in Cost Center}} \times 100 = \text{\% ABS}$.

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*In Organization I, the ABS measure was computed in essentially the same manner as in Organizations II and III, despite the fact that its verbal definition is different.

Examination of the predicted changes in ABS for Organization VI showed them to be the same magnitude as the predicted changes for Organization I, II, and III. This indicated that predicted changes from all four Organizations could be expressed in the form:

$$\%\text{ Predicted Change in ABS} = \frac{\text{Predicted Change in Person-days Absent}}{\text{Person-days Scheduled}} \times 100.$$

Thus, division of the Predicted Change in ABS by 100 and subsequent multiplication by the Person-days Scheduled for a cost center yielded the Predicted Change in Person-days Absent for that cost center. The predicted changes were then costed.

The number of Person-days Scheduled per cost center was estimated by multiplying the number of employees in the cost center by the number of work days in a month. The average number of employees in a cost center was estimated for each organization as the number of employees in the organization divided by the number of cost centers. The figures in Table 11 (Chapter 6) were used in this calculation. The average number of workdays in a month was assumed to be 20. We multiplied the predicted change in ABS for each cost center by the average number of Person-days Scheduled and aggregated the products to the organizational level. The total change in *percentage* ABS aggregated across cost centers for each organization is shown in Appendix K (Table K-1). Predicted change in ABS expressed as the number of *Person-days Absent* for each organization, is also shown in Appendix K (Table K-2). The figures in Table K-2 were the ones costed.

Before establishing the cost of these absence incidents, three items should be noted. First, in an actual implementation the denominator of the ABS measure would be known for each cost center for each month and would not have to be estimated as was done here. Second, in an actual application, the number of Person-days Scheduled would vary across cost centers. Thus, the predicted change in Person-days Absent would be computed at the cost center level. Finally, it is possible that the cost of these absences vary across cost centers. Therefore the costing procedure would also be done at the cost center level.

Relationship of Person-days Absent to Dollar Costs. There were no data available from any of our organizations regarding the cost of absence. However, Macy and Mirvis (1976) and Mirvis and Macy (1976) have estimated the cost of an incident of absence at a southern manufacturing plant for three consecutive annual periods (1972-1973, 1973-1974, 1974-1975), and at a bank for the period January through December, 1973. The cost per incident at the manufacturer were reported as \$55.36, \$53.15, and \$62.49 for three years and the cost at the bank was reported as \$98.22. Our measure of Person-days Absent was not identical to the definition of an absence incident used in calculating the above dollar figures. The measures were roughly comparable, however, and the dollar costs reported are useful for identifying a realistic range for the cost of absence in this illustration.

As with TVE, the cost of ABS was estimated using three levels of costs. The figures selected were \$40, \$80, and \$120 per absence. They represented low, medium, and high costs of scheduled person-days.

Multiplication of the predicted change in number of absences by these three estimates resulted in the predicted cost changes shown in Table 16.

Influences on the Costing Relationship

There are a wide variety of factors which influence the cost of Person-days Absent or the size of an engineered Dollar Standard. These factors include the cost of wages and fringe benefits, policies for replacement of personnel, effect of absences on the production process, predictability of absences, nature of the production process, the cost of scrap which does not meet quality standards, and the effects of unplanned machine down time and inadequate maintenance. The cost of figures for the two performance measures here were selected to represent a wide range of existing conditions. To the extent that any figure is "typical" across the heterogeneous organizations in a modern society, the middle figures ($55,715 for TVE & $80 for ABS) were our typical figures.

Besides the variety of influences on the magnitude of the cost changes, there are factors which affect the accuracy (& subsequently the magnitude) of the results. These factors concern the definition and measurement of performance and its relationship to costs.

Performance criteria are often defined as a ratio: $\frac{\text{actual performance}}{\text{expected performance}}$. A change in the ratio can result from changes in either the numerator or the denominator. However, only those due to changes in the numerator would be predicted effects of changes in the human organization.

Table 16

DOLLAR VALUE OF PREDICTED CHANGE IN ABS FOR EACH ORGANIZATION, BY PERIOD

		N	C	D	E	F	G	H	I	J
Cost = $40	ORG I	10	-132	488	-88	-292	272	-252	-424	232
	ORG II	15	52	432	92	16	-568	-164	1404	32
	ORG III	11	-1720	52	-1164	-584	232	44	636	132
	ORG VI									
	Plant 2	20	-1444	1464	344	-80	52	-1028	612	-160
	Plant 3	30	452	1440	744	-1788	628	492	-2556	1212
		N	C	D	E	F	G	H	I	J
Cost = $80	ORG I	10	-264	976	-176	-584	544	-504	-848	464
	ORG II	15	104	864	184	32	-1136	-328	2808	64
	ORG III	11	-3440	104	-2328	-1168	464	88	1272	264
	ORG VI									
	Plant 2	20	-2888	2928	688	-160	104	-2056	1224	-320
	Plant 3	36	904	2880	1488	-3576	1256	984	-5112	2424
		N	C	D	E	F	G	H	I	J
Cost = $120	ORG I	10	-396	1464	-264	-876	816	-756	-1272	696
	ORG II	15	156	1296	276	48	-1704	-492	4212	96
	ORG III	11	-5160	156	-3492	-1752	696	132	1908	396
	ORG VI									
	Plant 2	20	-4332	4392	1032	-240	156	-3084	1836	-480
	Plant 3	36	1356	4320	2232	-5364	1884	1476	-7668	3636

Take a hypothetical cost center where there are 500 Person-days Scheduled and 50 Person-days Absent in month T_0+k, yielding an ABS ratio of 10%.

There are two parameters affecting the predicted change in person-days absent for month T_0'+k, namely, the numerator and the denominator in the absence rate measure. Predicted changes in absence using the FPTI equations are expressed in terms of ΔABS%. To cost the predicted absence, however, percentage change is converted to change in Person-days Absent (the numerator of the ratio). The conversion is accomplished by multiplying the predicted ΔABS% by the Person-days Scheduled (the denominator of the ratio). Because of this conversion procedure, a change in the Person-days Scheduled affects the projected number of Person-days Absent. Since the cost changes associated with this projection are not due to changes in SOO measures, the accuracy of the cost figures for the human organization is reduced.

Table 17 is an illustration of the effects of changing "standards." In this case the standard is Person-days Scheduled. Four situations are examined regarding the prediction for month T_0'+k. In Cell 1, there is no change in ABS% predicted and there are 500 Person-days Scheduled. Cell 2 shows no ΔABS% predicted but an increase in person-days Scheduled to 750. Cells 3 and 4 show a predicted decrease in ABS from 10% at T_0+k to 5% at T_0'+k with 500 and 750 Person-days Scheduled, respectively. The question is, what do our predictions about ABS, converted to number of Person-days Absent, mean in each of these four cases?

Table 17

PREDICTED CHANGES IN ABSENCE:

THE EFFECTS OF CHANGING PERSON-DAYS SCHEDULED

$$\text{ABS\% for month } T_o+k = \frac{\text{50 Person-Days Absent}}{\text{500 Person-Days Scheduled}} = 10\%$$

ΔABS% Predicted for month $T_o'+k$		Person-Days Scheduled: 500		750	
		Δ in Predicted-Person-Days Absent due to Human Organization	Total Predicted Δ in Person-Days Absent	Δ in Predicted Person-Days Absent due to Human Organization	Total Predicted Δ in Person-Days Absent
	0%	Cell 1: No change	No change	Cell 2: No change	+25 Person-days
	-5%	Cell 3: -25 Person Days	-25 Person-Days	Cell 4: -25 Person-Days	-37.5 Person-Days

The results in Cell 1 are clear. Predicted change in ABS% for T_0+k is zero and the predicted change in number of Person-days Absent is zero. In Cell 2, however, the situation is different. There is no change in ABS% predicted and, according to our procedure, no change predicted in the number of Person-days Absent. However, an ABS rate of 10% with 750 Person-days Scheduled, will mean 75 Person-days Absent, i.e., an increase of 25 Person-days Absent. The dilemma is an artificial one, however. We have predicted no change in Absence rate (ABS) due to changes in the state of the human organization. The projected increase in Person-days Absent is not due to a change in the state of the human organization but simply to an increase in the number of Person-days Scheduled. Thus, in Cell 2 predicting no change is correct, even though the absolute number of Person-days Absent will increase from 50 to 75.

In Cells 3 and 4 there are parallel situations. In Cell 3 the predicted change in ABS and Person-days Absent is -5% and -25 Person-days, respectively. This can be attributed to a change in the human organization. In Cell 4 the predicted change in ABS is also -5% but the change in Person-days Absent is -37.5. Only 25 days is attributable to change in the human organization. Here the improvement in Person-days Absent is attributable to a change in the human organization interacting with a change in the number of Person-days Scheduled. The situation in Cell 4 is typical of the predictions made in this study and of the conditions to be expected in an actual implementation.*

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*This issue is relevant whenever the performance measure is a ratio. Thus, a similar analysis could be done for predicted changes in TVE.

In addition to these four situations, there are two additional ways in which the use of a ratio as a criterion may influence the accuracy of prediction. The FPTI method assumes the same predictor-criterion relationship across different values of the denominator from T_o+k to T_o'+k. However, there are two mechanisms whereby changes in the denominators of the performance measure result in applying the equations inappropriately.

First, the denominator may represent an important characteristic of the organizational unit. A unit that has 500 Person-days Scheduled for a month is probably different from one that has 150 Person-days Scheduled. Two units with this difference may also differ in the way the human organization relates to performance.

Secondly, when the denominators at T_o'+k are extreme, relative to their values at T_o+k, the performance scores observed at T_o'+k *may be* outside the range of scores for which the equation at T_o+k was developed. Thus we would be predicting a population of scores at T_o'+k different from the population of scores at T_o+k. To the extent this happens, there may be changes in the predictor-criterion relationship from T_o+k to T_o'+k. This issue is explored further in a later section.

5. Period to Month Conversion

Thus far, the value attribution process has been conducted using performance periods. The discounting process requires that the timing of cost changes be expressed in time units of known real duration. Thus predictions made for performance periods must be converted to performance months.

Performance periods were originally defined separately for each measure and organization so that all monthly performance scores assigned to a performance period were (1) sequential and (2) more similar to each other than to scores for months not in the period. The performance scores for each period were computed as the average of the monthly scores in the period.

To convert back to performance months, the changes predicted for each equivalent performance period were assigned to each month included in the period. When no data were available for an organization for given months, a representative predicted change was assigned for these months.*

The dollar value of predicted changes for months T_0+1 through T_0+12 are shown in Appendix L. The organization-month cells labeled *with an asterisk are those where the only prediction available was that* made by an equation where the organization concerned was not represented in the data used to develop the prediction equations. The predictions made for these organization-period combinations are less accurate than those made for combinations where the organization was represented in the calculation of the prediction equation. These less accurate predictions were included to provide a complete set of predictions for 12 months for each organization.

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*See Lapointe, et al., 1978 pp. 59-62 for details.

6. Capitalization and Discounting

Future income is discounted to present value because the income to be received in the future is of less value than the same income received today. Money in hand can be invested at a given interest rate and thus has earning power. Capitalization determines the investment value of a "property." Since it is the present values that are capitalized, we first discounted the anticipated income shown in Appendix L and then capitalized.

DISCOUNTING

The key factors in discounting are (1) the timing of anticipated income, and (2) the interest rate. Estimating the timing of the cost changes was implicit in the prediction process. We will discount to T_0'. Therefore, the month k after T_0' in which a cost change is predicted to occur, is equal to the number of months over which the cost change must be discounted.

The interest rate to be used may be selected according to several criteria. The average cost of a loan of similar size and duration is one criterion. The interest available if the funds were invested can also be used. In an FPTI implementation, the situation of the organization would determine the rate. Our desire here is to provide an illustration. Too low an interest rate will result in the current value being higher than is realistic; too high a rate will have the opposite effect. We selected a monthly interest rate of 1%. Compounded monthly, this is equal to an annual rate 12.81%.

Using the discounting or present value formula, we have:

$$PV = \sum_{k=1}^{12} \frac{PC_k}{(1+i)^k}$$

PC is the predicted cost change in each cell of Tables M-1 and M-2

k is the month for the predicted cost change.

$i = .01.$

The Present Value of predicted costs changes for each month are shown in Appendix M. Tables 18 and 19 show the sum of these Present Values for each organization and for the composite organization. The Present Value of the predicted changes for each organization is shown on a per cost center, per work group and per person basis.

CAPITALIZATION

There are three key quantities in capitalization. The first is the amount of income to be capitalized. This is provided by the present values from Tables 18 and 19. The second is the rate of return. In the present study this was taken from the 1971 FORTUNE 500 listing for each of the five organizations. The net income as a percent of stockholder equity was doubled to estimate the before-tax rate of return. The average of this figure across all five organizations was used as the rate of return for capitalization of the present values. The average rate of return was 16%.

The final quantity necessary for capitalization is an estimation of the duration of the anticipated stream of income. As discussed in Chapter 2, the duration of changes in the human organization is at present unknown. We assumed that these.changes continued, as

Table 18

PRESENT VALUE OF PREDICTED CHANGES IN TVE

	Total[1]	Per Cost Center	Per Work Group	Per Person
Dollar Standard = $20,887				
ORG II	-2780	-185	-45	-10
ORG III	-5160	-469	-32	-4
ORG IV	-4886	-349	-47	-5
ORG VI				
Plant 1	-1165	-38	-24	-3
Plant 2	-2154	-108	-57	-5
Plant 3	-12141	-337	-132	-11
Composite:	-28286	-223	-56	-6
Dollar Standard = $55,715				
ORG II	-7414	-494	-120	-27
ORG III	-13765	-1251	-85	-11
ORG IV	-13034	-931	-125	-13
ORG VI				
Plant 1	-3107	-100	-63	-7
Plant 2	-5745	-287	-151	-13
Plant 3	-32387	-900	-352	-29
Composite:	-75452	-594	-149	-17
Dollar Standard = $144,150				
ORG II	-19181	-1279	-309	-69
ORG III	-35614	-3238	-220	-29
ORG IV	-33723	-2409	-324	-34
ORG VI				
Plant 1	-8071	-260	-165	-19
Plant 2	-14864	-743	-391	-35
Plant 3	-83793	-2328	-911	-74
Composite:	-195246	-1537	-385	-43

[1]All figures rounded to nearest dollar

Table 19

PRESENT VALUE OF PREDICTED CHANGES IN ABS

	Total[1]	Per Cost Center	Per Work Group	Per Person
Cost = $40				
ORG I	143	14	8	1
ORG II	2480	165	40	9
ORG III	-1460	-133	-9	-1
ORG VI				
Plant 2	-1521	-26	-14	-1
Plant 3	2934	82	32	3
Composite:	3576	39	10	1
Cost = $80				
ORG I	284	28	15	2
ORG II	4961	331	80	18
ORG III	-2918	-265	-18	-2
ORG VI				
Plant 2	-1042	-52	-27	-2
Plant 3	5864	163	64	5
Composite:	7149	78	19	2
Cost = $120				
ORG I	426	43	22	3
ORG II	7442	496	120	27
ORG III	-4377	-397	-27	-4
ORG VI				
Plant 2	-1563	-78	-41	-4
Plant 3	8796	244	96	8
Composite:	10724	117	29	3

[1] All figures rounded to nearest dollar

calculated for the first year, in perpetuity. That is, we did not assume that the value of the changes increased or decreased during the first year.

Capitalization consisted of dividing the present values in Tables 18 and 19 by the rate of return. The result is shown in Table 20.* The sign of the capitalized values has been reversed from previous tables so that a positive value indicates an increase in the investment value and a negative value indicates a decrease in investment value of the organization.

Summary

The results of the value attribution demonstration do not correspond to what might be expected for any single organization. Thus, there is little point in a detailed discussion of the results of each step of the demonstration. Certain features are notable, however. All the present values associated with TVE (Table 18) were in the expected direction. Those for ABS (Table 19) were mixed, although many of the cost changes in the unexpected direction (approximately 50%) were found in month-organization cells marked with an asterisk (*). The "*" indicated that a prediction was made for the organization in that cell even though that organization was not represented in the sample used to develop the prediction equations originally (see Table L-2 in Appendix L). Thus, these were less accurate predictions. The absolute

*Customary accounting practice is to capitalize only income which will occur beyond the current fiscal year. Expenses or income occurring during the current fiscal year are treated as current income or current expenses. In this example no attempt has been made to simulate a portion of the anticipated income occurring during the current fiscal year. Instead, all anticipated income has been capitalized.

Table 20

CAPITALIZED PRESENT VALUES FOR TVE AND ABS

		TVE	
Dollar Standard:	$20,887	$55,715	$144,150
ORG II	17375	46338	119881
ORG III	32250	86031	222588
ORG IV	30538	81462	210769
ORG VI			
Plant 1	7281	19419	50444
Plant 2	13463	35906	92900
Plant 3	75881	202419	521831
Composite:	176788	471575	1220288
		ABS	
Cost:	$40	$80	$120
ORG I	-894	-1775	-2663
ORG II	-15580	-31006	-46513
ORG III	9125	18238	27356
ORG VI			
Plant 2	3256	6513	9769
Plant 3	-18338	-36650	-54975
Composite:	-22350	-44681	-67025

Note: All signs in this table are reversed from previous tables. Positive values show capitalization of an asset. Negative values show capitalized value of a liability.

magnitudes of the TVE values were uniformly larger than for ABS, although for Organization II the difference was slight. This was due to two factors. One was the larger multiplier used for the valuation of the TVE changes. The second factor was the greater number of positive predictions (i.e., predictions in the unexpected direction) for ABS relative to TVE (Appendix M) which, when summed across periods, resulted in smaller absolute magnitudes.

A third feature of the ABS and TVE results arose from the definition of the measures and their valuation. The costs represented for each criterion were not independent of costs for the other criteria. However, the results of this illustration indicate that even moderate changes in the human organization can be of significant value to the organization.

VARIATION ACROSS PREDICTOR MEASUREMENTS

Predicting performance changes using observed human organization-performance relationships assumes no change in the relationship for a given time lag value between two measurements of the human organization. Two procedures were used to examine the validity of this assumption.* The first technique tested the equivalency of the beta coefficients for comparable times subsequent to each SOO administration. The second procedure examined the agreement between predicted and actual performance

*These two investigations are not described here. Readers interested in the techniques and statistical findings should refer to Lapointe, et al., 1978, pp: 80-85.

scores. The results were inconclusive. Nevertheless, two points were evident. First, an actual implementation of FPTI should strive to eliminate the constraints in this illustration (e.g., small N of performance cost centers, performance measures not defined according to FPTI criteria, missing data). Second, prediction equations will require continual monitoring and updating in order to test and insure their validity across time and events.

In summary, it has been shown that the Current Value approach to human resources accounting is possible. Its practicality depends upon satisfactory resolution of several issues of utilization and implementation. Section IV addresses several of these issues.

CHAPTER 8

EXTENSION OF CURRENT VALUE HRA TO THE NAVY

Previous chapters have described the methods and concepts, and then examined empirical relationships required, for a system of future performance trend indicators. Equations for each of a number of performance periods were generated, and value attribution procedures were used to estimate the present value of predicted performance changes.

In all of these previous chapters, civilian data from the Survey of Organizations data bank were combined to form a hypothetical composite organization. In the present instance, our attention turns to the extent to which the relationships obtained and the requirements met with the civilian data set are replicated in Navy data. These Navy data had been for an earlier study from the Navy Human Resource Management Survey (HRMS) data bank and from an extensive management information system maintained by the Navy (Drexler & Franklin, 1976; Franklin & Drexler, 1976)

Thus far, findings have demonstrated the feasibility of a system of future performance trend indicators in the civilian sector. In this chapter the feasibility of extending FPTI's to the Navy is tested.

Specifically, the first four of the six original requirements (Pecorella & Bowers, 1976) are re-examined with the Navy, its functioning, and the performance of its units in mind:

(1) Is there available scientific evidence which identifies key dimensions of Navy organizations?

(2) Are there adequate methodology and instruments for measuring these key dimensions?

(3) Are there reliable and valid Navy performance data?

(4) Are there relationships between key dimensions of Navy organizations and performance outcomes?

Taking the first of these questions, there has accumulated a significant volume of evidence extending the key dimensions found in the Survey of Organizations, and used in the civilian analyses earlier in this present project to Navy settings. The first of these came from a complex project supported by the Manpower R&D Program of the Office of Naval Research. Summarized in Manpower Series Report IV (Bowers, 1975), the findings indicated the following:

(1) Far from being unlike civilian organizations in form and functioning, Navy units display the same sorts of relationships and properties as their civilian counterparts.

(2) Differences between preferences and experiences in Navy units are very similar to those present in civilian organizations.

(3) Constructs measured for Navy units display patterns of relationships quite comparable to those obtained in civilian organizations.

(4) Types of groups encountered in Navy units are similar to those encountered in civilian organizations.

(5) Satisfaction and motivation of persons in Navy units relate to the same sorts of practices and interpersonal conditions found to yield them in civilian organizations.

In short, this first project demonstrated strong parallels between what was associated with effectiveness of civilian organizations and what related to effectiveness of Navy units. It suggested that the key dimensions of Navy human organizations are very similar to the key dimensions of civilian organizations.

This has been largely confirmed in subsequent research. Beginning in August, 1973, representatives of the Navy's Human Resources Management Program met with persons from ISR to modify the Survey of Organizations for Navy use. Some SOO indexes or dimensions were reworded slightly or retitled to make them more compatible with Navy customs (e.g., "Organizational Climate" became "Command Climate"). Some additional measures were added, particularly in the social concern areas of equal opportunity and drug/alcohol abuse and in the area of military discipline.

Between December, 1973, and March, 1975, this Navy instrument, entitled the Human Resource Management Survey (HRMS), went through eight revisions. These forms were basically similar, but included additions of new items, deletions of some items, and minor modifications. Drexler subsequently used an accumulation of approximately 65,000 HRMS cases to analyze the internal structure of the survey (Drexler, 1974).

Using smallest space analysis (Guttman, 1968), he identified the following areas and indexes as contained in the HRMS:

CONCEPTUAL AREA	INDEXES
Supervisory Leadership	Support Team Building Goal Emphasis Work Facilitation
Work Group (Peer) Behavior	Peer Support Peer Work Facilitation Peer Problem Solving Peer Team Work
Work Group Emergents	Group Processes Group Readiness Group Discipline
Command Climate	Human Resource Emphasis Motivational Conditions Decision Making Practices Communication Flow
Content Dimensions	Career Counseling Equal Opportunity Supervisor's Responsiveness to Drug Abuse Supervisor's Responsiveness to Alcohol Abuse Transition
Outcome Dimenions	Overall Satisfaction Satisfaction with Progress Work Affect Integration of Men and Mission

Thus the structure of the common or "core" content of the HRMS appeared from Drexler's analysis to be nearly identical to that of the SOO. Wilcove (1976) used factor analysis in a repeat investigation and obtained findings similar to Drexler's. In both of these studies, analyses were conducted within areas having a common referent, thus

eliminating the tendency for factors to emerge largely by referent alone. Sachar (1976), in a separate study, also used factor analysis in separate analyses of the sea and shore versions of the HRMS. In this instance, analyses were done in the aggregate, rather than by referent area, to assess internal structure of the survey. Her analyses confirmed what has been found elsewhere, that major "blocks" of common-referent content exist. Thus, it appears that the key dimensions of command functioning in the Navy are substantially the same as those of civilian organizations, and that the HRMS as an instrument provides a method analogous to that of the SOO for assessing those dimensions.

The third and fourth assumptions -- availability of performance measures and knowledge of the relationships of key dimensions to them -- involve a somewhat wider array of evidence. At the outset, it is useful to recall the earlier work by Dunnette and his colleagues, cited in the first report in the series (Dunnette, Milkovich, & Motowidlo, 1973; Borman & Dunnette, 1974). They identified the requirements for a Navy personnel status index using results from a policy-capturing procedure which were subsequently factor analyzed. These investigators identified three essential domains of Navy outcome indicators: retention rate, readiness, and discipline.

Within the last five years there has accumulated an impressive array of evidence indicating that key HRMS indicators (or in at least two instances their SOO equivalents) relate predictably to outcomes in each of these domains. For example, Crawford and Thomas (1976) found HRMS measures to be significantly correlated with non-judicial punishment rates aboard Navy ships. In the area of retention rate, Drexler and

Bowers (1973) found significant correlations to actual reenlistment rates of 22 Navy units. Bowers (1973) validated a measure of reenlistment intention and found that five factors from the SOO were strongly related to that intention. Franklin and Drexler (1976) found significant relationships of HRMS indicators to reenlistment rate aboard nearly 100 Navy ships. Finally, Shields and Walls (1978) cite an unpublished briefing in which HRMS indexes were related to retention rate aboard submarines.

In the readiness area, several studies have also indicated significant and directionally appropriate relationships. Mumford (1976) found significant relationships of HRMS indexes to performance of Navy ships in refresher training exercises. Shields and Walls (1978) found relationships of HRMS indexes to maintenance proficiency of aviation squadrons and (in the same unpublished briefing cited earlier) to submarine propulsion safeguard examination evaluations. Siegried and West (1977) found HRMS scores to be related to safety performance in fighter aircraft squadrons. Finally, Franklin and Drexler (1976) found consistent and frequently significant relationships of HRMS indexes to FORSTAT measures of operational readiness.

Thus the weight of evidence strongly suggests that (a) performance domains for Navy units can be identified, (b) some measures of acceptable quality exist in these domains, and (c) HRMS indexes relate to these performance measures in ways quite similar to their SOO/civilian counterparts.

The four main assumptions would therefore appear to be adequately satisfied to begin the transition from civilian to Navy applications. An important addendum lies in the fact that Franklin and Drexler (1976) found a two-peak pattern of concurrent and predictive relationships almost identical to that obtained in this present study for civilian data. However, all coefficients presented in the Franklin and Drexler report were zero-order; no multivariate predictions were undertaken for that study.

In the present instance, therefore, it seemed useful to reanalyze the Franklin and Drexler data set using multiple regression techniques. Because the case count of organizational units is small compared to those in the present study's civilian data set, the cross-validation procedure could not be undertaken. Still, the findings may be taken with some caution as suggestive, provided they appear to replicate those in the civilian sector.

Data and Methods

Measures of organizational functioning in the Franklin and Drexler data set were obtained from the HRMS data bank which, at that time, contained the responses of approximately 65,000 Navy personnel. Reenlistment data were obtained from the Bureau of Naval Personnel for nearly 300 units. Five types of operational readiness data were also obtained for roughly 100 units. Both the reenlistment and operational readiness data were standardized and relativized to remove extraneous, severe variation across time, plus seasonal fluctuations. Readiness

data were aggregated from daily ratings to one-month averages for six-months prior to, and six-months subsequent to, the time (T_0) of survey administration. Reenlistment data were aggregated into four-month periods where T_0 included the reenlistment rate for the month of the survey plus the three subsequent months.

The readiness measures consisted of ratings in five areas:

Personnel Readiness (P) - rating of actual personnel strength versus structured strength.

Equipment and Supplies on Hand (S) - rating of essential equipment on hand versus that allowed for a unit.

Equipment Readiness (E) - rating of availability and condition of mission-essential equipment.

Training (T) - rating of unit's ability to perform against standards set for a unit of its type.

Overall Readiness (R) - summary of above ratings plus the unit's performance re: stand down, morale, actual qualifications of individuals, and environment.

Two reenlistment measures were used, representing periods within the July 1974 - June 1975 time frame:

Total Reenlistment - the ratio of the number of persons in the unit reenlisting to the total number in the unit eligible to reenlist.

First-Term Reenlistment - the ratio of the number of first-term persons in the unit reenlisting to the total number of first-term persons eligible to reenlist.

For each of the two kinds of criteria (readiness & reenlistment rate) a decision was made to standardize performance scores within the unit and then relativize in terms of time prior to and after survey measurement. As such, these procedures were the same as those used in the civilian analyses of the present project.

The statistical technique employed in the analyses was that of linear multiple regression, using the MIDAS software system of the University of Michigan Computing Center (Fox & Guire, 1976).

Results

Table 21 presents multiple regression results, predicting each of the five Readiness measures by time period from (a) Command Climate indexes, (b) Supervisory Leadership indexes, (c) Peer Leadership indexes, and (d) the four dimensions, i.e., the mean of each of the three areas above (a to c) plus the group coordination index. Several facts emerged from these analyses:

- There were roughly twice as many significant coefficients in the total table as one would expect by chance alone.
- When we split the table into time frames -6 through 0 (near past/contemporary) and +1 through +6 (immediate future), we found that there were three or four times as many significant coefficients in the later time frame as in the earlier time frame.
- This mass of coefficients in the later time frame occurred primarily in relation to Command Climate and Supervisory Leadership rather than in relation to Peer Leadership.

Table 21
MULTIPLE REGRESSIONS: 14 HRMS INDEXES AS PREDICTORS OF
OPERATIONAL READINESS FOR 13 TIME PERIODS

Readiness Measure	HRMS Index	R-6m	R-5m	R-4m	R-3m	R-2m	R-1m	Ro	R+1m	R+2m	R+3m	R+4m	R+5m	R+6m
Overall Readiness	Command Climate	.16	.20	.20	.22	.18	.22	.24	.35*	.32*	.27	.30	.28	.36
	Sup. Leadership	.27	.19	.28	.27	.23	.22	.26	.35*	.40**	.40**	.33*	.37	.39
	Peer Leadership	.20	.27	.28	.26	.27	.22	.28	.34*	.30	.27	.26	.29	.28
	4 Dimensions	.22	.23	.22	.19	.18	.24	.26	.35*	.32*	.30	.29	.31	.33
Personnel Readiness	Command Climate	.23	.28	.27	.20	.28	.25	.26	.29	.31	.33*	.34*	.40*	.41
	Sup. Leadership	.15	.13	.08	.15	.18	.11	.15	.14	.23	.24	.24	.35	.39
	Peer Leadership	.10	.11	.12	.24	.27	.19	.13	.15	.17	.19	.21	.23	.28
	4 Dimensions	.03	.08	.11	.18	.24	.19	.23	.27	.28	.29	.29	.36	.35
Equipment Readiness	Command Climate	.21	.31	.33	.34*	.26	.17	.17	.22	.22	.20	.20	.11	.18
	Sup. Leadership	.21	.13	.21	.14	.12	.20	.23	.16	.21	.23	.31	.33	.44
	Peer Leadership	.18	.05	.26	.32	.26	.24	.23	.26	.30	.26	.25	.35	.43
	4 Dimensions	.27	.23*	.26	.32	.33*	.21	.24	.18	.23	.27	.23	.19	.25
Equipment & Supplies	Command Climate	.28	.41**	.31	.22	.14	.25	.32	.35*	.31	.23	.32	.41*	.31
	Sup. Leadership	.22	.29	.35*	.25	.18	.22	.27	.39**	.40**	.43**	.33	.31	.28
	Peer Leadership	.23	.41**	.30	.24	.14	.23	.27	.33	.31	.33	.33	.29	.22
	4 Dimensions	.32	.45	.33	.22	.18	.26	.32	.37*	.32	.26	.30	.32	.28
Training	Command Climate	.12	.14	.15	.14	.18	.20	.18	.18	.23	.24	.18	.29	.46
	Sup. Leadership	.11	.14	.13	.12	.13	.15	.18	.22	.15	.15	.13	.25	.49*
	Peer Leadership	.13	.06	.18	.14	.11	.13	.10	.08	.14	.15	.14	.18	.26
	4 Dimensions	.28	.34*	.26	.32	.36*	.36*	.33	.37*	.41**	.40**	.34*	.32	.40
Average ($\bar{X}$) N		(81)	(86)	(84)	(85)	(85)	(85)	(86)	(84)	(84)	(84)	(85)	(60)	(46)

*p<.05

**p<.01

- Significant coefficients were concentrated in predictions of overall readiness, training, and equipment and supplies on hand. Except for the equipment and supplies measure, these readiness indicators were those more readily impacted by the human organization.
- The reason for the comparative infrequency of significance in the two latest periods (+5 & +6) was not so much that there was a drop in coefficient size (about as many absolutely rose as declined) as that the declining number of cases made statistical significance increasingly difficult.

Table 22 presents similar data in relationship to the two measures of retention rate -- Total Reenlistment and First-Term Reenlistment. The findings included the following:

- There were approximately twelve times as many significant coefficients in the total table as one would expect by chance alone.
- When we split the table into periods -1 and 0 (near past/contemporary) versus +1 through +3 (future), we found that:
  - high proportions of significant coefficients occurred in both time frames.
  - high proportions of significant coefficients occurred for all categories of predictors.
- Significant coefficients were much more frequent and were stronger in relation to total reenlistment rate than in relation to first-term reenlistments alone.
- For total reenlistment, significant coefficients in the later time frame were higher in magnitude than those in the earlier time frame.

Table 22

MULTIPLE REGRESSIONS: 13 HRMS INDEXES AS PREDICTORS OF

REENLISTMENT RATE FOR 5 TIME PERIODS

Reenlistment Measure	HRMS Indexes	T-1 (-4m → -1m)	To (0m → +3m)	T+1 (+4m → +7m)	T+2 (+8m → +11m)	T+3 (+12m → +16m)
Total Reenlistment	Command Climate†	.27	.48**	.50**	.30*	.21
	Sup. Leadership	.39*	.43**	.41**	.45**	.24
	Peer Leadership	.46**	.43**	.46**	.51**	.57**
	4 Dimensions	.38*	.45**	.48**	.48**	.30
1st Term Reenlistment	Command Climate†	.23	.39**	.27**	.26	.09
	Sup. Leadership	.32	.44**	.23*	.29	.31
	Peer Leadership	.33	.41**	.30**	.29	.32
	4 Dimensions	.25	.27*	.27**	.30*	.32
Average ($\overline{X}$) N		(70)	(157)	(178)	(102)	(37)

† Command Climate contained only three, instead of four, indexes for these analyses. Decision Making Practices was not included.

*=p<.05

**=p<.01

The findings support at least two conclusions that are instrumental to current value human resources accounting efforts in a Navy setting:

(1) There are indeed significant multivariate relationships between HRMS predictors and both reenlistment and Readiness performance measures, and these relationships -- as in the case of the civilian data set -- tend to occur more frequently after the time of the survey than before.

(2) There is clearly adequate evidence to merit further exploration of these measures for inclusion in any future performance trend indicator system that might be developed for Navy use.

There are also shortcomings, some of which reflect the data set used in the analysis, rather than anything necessarily characteristic of the problem posed or the true relationships that exist. For example, there was some suggestion that collapsing predictors into dimension scores (command climate as a single index, etc.), while made necessary to work with the number of available cases, resulted in the loss of valuable variance. Second, there was some suggestion as well that the loss of cases in later periods may have reduced the frequency of significance as well as in loss of valuable variance.

These potential losses are illustrated in Tables 23 and 24, where mean zero-order and various multivariate coefficients are presented. In a "strong" period in the later time frame of readiness, for example, the size of the correlations went up from the low .20's for mean zero-order relationships, to the high .20's and .30's for multivariate relationships using four predictors. When all 13 or 14 indexes were

Table 23

RELATIONSHIPS OF <u>HRMS</u> INDEXES TO OVERALL READINESS:

ZERO-ORDER (r) AND MULTIVARIATE (R) CORRELATIONS

	R-6m	R-5m	R-4m	R-3m	R-2m	R-1m	Ro	R+1m	R+2m	R+3m	R+4m	R+5m	R+6m
Mean r, Climate	.01	-.09	-.20	-.18	-.17	-.17	-.21*	-.32*	-.28*	-.22*	-.25*	-.24*	-.27*
Mean r, Supervisory Leadership	-.03	-.15	-.20	-.16	-.15	-.18	-.22*	-.31*	-.25*	-.21*	-.20	-.21	-.24
Mean r, Peer Leadership	-.06	-.18	-.19	-.16	-.15	-.20	-.23*	-.31*	-.26*	-.22*	-.21*	-.24*	-.27*
r, Group Coordination	-.02	-.14	-.21*	-.18	-.16	-.16	-.22*	-.33*	-.29*	-.23*	-.23*	-.20	-.23
R, 4 Climate	.16	.20	.20	.22	.18	.22	.24	.35*	.32*	.27	.30	.28	.36
R, 4 Supervisory Leadership	.27	.19	.28	.27	.23	.22	.26	.35*	.40*	.40*	.33*	.37	.39
R, 4 Peer Leadership	.20	.27	.28	.26	.27	.22	.28	.34*	.30	.27	.26	.29	.28
R, 4 Dimensions	.22	.23	.22	.19	.18	.24	.26	.35*	.32*	.30	.29	.31	.33
R, 14 Indexes	.42	.44	.44	.43	.40	.37	.36	.43	.50	.52*	.45	.45	.57

Table 24

RELATIONSHIPS OF HRMS INDEXES TO
TOTAL REENLISTMENT RATE: ZERO-ORDER (r)
AND MULTIVARIATE (R) CORRELATIONS

	T-1	To	T+1	T+2	T+3
Mean r, Climate	.32	.43	.44	.26	.03
Mean r, Supervisory Leadership	.27	.35	.36	.36	.19
Mean r, Peer Leadership	.29	.35	.39	.45	.12
r, Group Coordination	.34*	.41*	.39*	.40*	.13
R, 4 Climate	.27	.48*	.50*	.30*	.21
R, 4 Supervisory Leadership	.39*	.43*	.41*	.45*	.24
R, 4 Peer Leadership	.46*	.43*	.46*	.51*	.57*
R, 4 Dimensions	.38*	.45*	.48*	.48*	.30
R, 13 Indexes	.53	.53*	.54*	.56*	.65
Average (X) N	(70)	(157)	(178)	(102)	(37)

included in a single prediction, however, a large gain was clearly registered, with the relationships reaching the high .40's and .50's.

Given the restricted number of cases, the latter step raises a question of whether the observed gains simply result from characteristics unique to the present sample -- that the observed relationships would not extend to any other sample drawn from the same population. Some reassurance on this issue is provided from Tables 25 and 26, which present somewhat similar extractions for TVE and ABS in the civilian analyses reported earlier. There, as here, a substantial gain was registered as one moved from zero-order to multivariate relationships. In that set of instances, however, the relationships did double cross-validate. While this proves nothing concerning the present set of Navy data, it is at least cause for some optimism that, given an adequate number of cases and an opportunity to double cross-validate, the relationships would hold up.

Conclusions and an Illustration of Value Attribution

These findings provide rather persuasive evidence that the base for a current value system of human resources accounting does, in fact, exist in Navy settings using Navy data. Not only are the basic requirements -- the four assumptions -- met by accumulated evidence from earlier research, but also the present evidence suggests that multivariate relationships of respectable size exist for Navy units as well.

The potential value of such a system may be illustrated by a purely hypothetical set of values. Let us assume that, as a result of successful HRMS work, there were the following changes in HRMS dimension scores:

Table 25

RELATIONSHIPS OF SOO INDEXES TO TOTAL VARIABLE EXPENSE:

ZERO-ORDER (r) AND MULTIVARIATE (R) CORRELATIONS

	Span 1 (-8m → -1m)	Span 2 (0m → +8m)	Span 3 (+9m → +15m)	Span 4 (+16m → +24m)	Span 5 (+25m → +28m)
Mean r, Climate	-.12	-.05	.04	-.06	.16
Mean r, Supervisory Leadership	-.05	-.03	.01	-.07	.01
Mean r, Peer Leadership	-.02	.03	-.01	-.01	.06
Mean R, 13 Indexes	.39	.31	.48	.42	.32

*Mean r represents the average of approximately 24 to 48 zero-order correlations, both positive and negative, computed by index for each period for each organization.

Table 26

RELATIONSHIPS OF SOO INDEXES TO ABSENCE RATE:

ZERO-ORDER (r) AND MULTIVARIATE (R) CORRELATIONS

	Span 1 (-6m → -1m)	Span 2 (0m → +4m)	Span 2a (+5m → +8m)	Span 3 (+9m → +18m)
Mean r, Climate	-.10	-.04	-.07	-.07
Mean r, Supervisory Leadership	-.13	-.07	.00	-.09
Mean r, Peer Leadership	-.11	-.07	-.12	-.10
Mean R, 13 Indexes	.37	.27	.33	.46

*Mean r represents the average of approximately 24 to 48 zero order correlations, both positive and negative, computed by index for each period for each organization.

Dimension	Change in Dimension Score
Command Climate	+.25
Supervisory Leadership	+.50
Peer Leadership	+.75
Work Group Coordination	+1.00

These change scores would be multiplied by a set of regression weights. For illustration purposes, let us use the following figures:

Dimension	Regression Weights for a Given Performance Period
Command Climate	.20
Supervisory Leadership	.10
Peer Leadership	.20
Work Group Coordination	.15

Using these values, we would get .20(.25)+.10(.50)+.20(.75)+.15(1.00) or +.85 as the predicted change in reenlistment rate for a particular performance period. If the standard deviation for reenlistment rate across units were 10 percent, the predicted gain in total reenlistments would be .85(.10) or 8.5 percent of those eligible. Of 100 eligibles, therefore, 8.5 more would reenlist than would otherwise be the case.

Carrying this illustration one step further, if the recruiting and training costs associated with each of the replacements were $10,000, the savings generated from the improvement in the human organization would amount to 8.5 ($10,000) or $85,000.

While the values assumed in this illustration are hypothetical, the bases and relationships are very realistic in terms of the findings of this present study. It is in such possibilities as that suggested in the illustration that the potential worth of future performance trend

indicators lies. Actions and policies with potential costs and benefits in other, more conventionally tangible areas have possible human organization consequences as well. Without some system such as that demonstrated by the reports in this series, these consequences may well be overlooked and inappropriate courses set. The results of the present analysis suggest that a current value human resources accounting system in the Navy is, in fact, feasible.

Summary

Previous chapters in this report have demonstrated the feasibility of future performance trend indicators (FPTI) in civlian organizations. In this chapter, the basis has been laid for extending FPTI systems to the Navy. Using linear multiple regression as the analysis technique, the obtained relationships between HRMS indexes and both reenlistment and readiness performance measures are statistically significant in proportions for exceeding what would be expected by chance. There is clearly adequate evidence to merit further development of FPTI systems in the Navy.

SECTION IV

UTILIZATION ISSUES

Preceding sections have described results which support the feasibility of current-value human resources accounting. The actual adoption of HRA as an integral part of management decision-making will now depend largely on an adequate resolution of several procedural and ethical issues. Section IV (Chapters 9 & 10) addresses these issues and offers some alternatives for handling them.

Chapter 9 focuses on the procedural, or design, complexities in current-value HRA. The design of an "ideal" current-value HRA system is viewed in the context of two basic issues, namely, the *strength* and *accuracy* of prediction.

In Chapter 10, the focus shifts to the potential impact of a current-value HRA system on various "stakeholders" (e.g., organizational decision makers, workers, citizens). The importance of a well-implemented HRA system, as well as a well-designed one, is emphasized.

CHAPTER 9

THE DESIGN OF

CURRENT-VALUE HRA SYSTEMS

The research described in previous chapters has illustrated the major processes involved in the creation of Future Performance Trend Indicators. The results suggest that such a system of current-value human resources accounting is indeed feasible.

One might expect that implementation and utilization of such a system would be no problem. Once successfully demonstrated, managers would presumably rush to adopt this human factor "early warning system." However, utilization of new research findings does not occur all that readily. Despite the researcher's articles of faith, solid findings do not sell themselves.

Instead, utilization occurs as the result of the ability of the research "community" and the user "community" to interact constructively. That is, these two communities need to be responsive to each others language, thought processes, and concerns (Caplan, 1973; Havelock, 1973; Havelock & Havelock, 1973).

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Some of these concerns are methodological in origin. They reflect differences in concepts and procedures of sharing, processing, and analyzing information. Like unfamiliarity in any setting, these differences produce mistrust and wariness. For example, social and behavioral science deal customarily in probabilities, while accounting deals more nearly in complete certainties. The organizational scientist is therefore pleased with the 50 percent of outcome variance which is accounted for, while the accountant sees the half that remains unknown and treats the results with some skepticism.

Of course, there are other sources of potential resistance to implementing the findings of this research, such as preferences for management styles at odds with those which underlie the prediction system, and affinity for hardware rather than the human organization. However, it is to methodological questions and obstacles that this chapter turns. Our belief is that major progress in designing and implementing a current value HRA system may be made by addressing them in some detail.

The sections which follow treat a number of these issues in fairly formal and technical fashion. The basic questions may be stated much more informally, however (Bowers & Davenport, 1978):

(1) Aren't the predictions made in these reports marginal? Isn't there a great deal of unaccounted-for variance in outcomes, more even than what is accounted for?

(2) Aren't such things as dollar value, discounting, and capitalization commercial-world notions that are irrelevant to a military setting?

(3) Doesn't this research take a great deal for granted about what should and should not be included in a set of predictors for current value HRA?

(4) Isn't any system that predicts across time of limited usefulness to an organization, like the Navy, which has constant reorganization and turnover?

(5) Doesn't this research, if implemented, imply levels and frequencies of reporting that would overtax the FP;I system?

Of course, no ringing denial of these potential problems is possible. However, an exploration of the contributing methodological issues may scale the problems down to manageable size.

There are two parts in this chapter. Part One addresses broad issues of methodology which affect the basic validity and reliability of the FPTI prediction equations. Part Two shifts the focus to more specific issues and their implications for the design of current value HRA systems.

Part One

Broad Methodological Issues

The power and usefulness of the equations, upon which a current-value HRA system is based, are crucial to its acceptance. Two factors are relevant:

A. What is the strength of the prediction? More specifically,

- What proportion of the "true" performance variance can be explained by human organization predictors?

B. What is the generalizability of the prediction equations?

- Are there differences in beta weights across organizational units?
- How stable are the beta weights across time?

Each of these points is discussed in the remainder of Part One.

<u>Strength of Prediction</u>

The explanatory strength of HRA predictors as a group is indicated by the magnitude of the human organization-performance relationship. Ideally, the human organization predictors would explain all the variance in the performance measures which is under the control of individual effort.

The selection and definition of appropriate performance variables is an often oversimplified procedure. Two articles which discuss relevant issues in the identification of productivity measures conclude that, in spite of the difficulty of selecting such measures, it is exactly these measures which are central to the assessment of an organization (Macy & Mirvis, 1976; Mirvis & Macy, 1976).

At the outset, it's important to note the distinction between the real predictor and outcome properties (those that exist in the real world as actual events) and the measures used to operationalize them. The degree of support present in a supervisor's behavior is a real property of the system, of which our questionnaire three-item index is simply a reflection. Likewise, real performance is something different from the measures which we use to represent it.

These operational measures may be more or less "good" -- that is, in some measure they represent true variance in the predictor characteristic, or true variance in the criterion, but they contain both systematic and random error as well. For example, a particular index value on supervisory support reflects the actual degree of supportiveness present in that supervisor's behavior in a recent time period. However, to some degree it also represents such unrelated things as positive or negative response set and random error. Likewise, an index of absenteeism reflects in part real absenteeism and in part such things as a timekeeper's favoritism and random mistakes on entries.

We assess the "goodness" of our measures by commonly accepted indexes of reliability and validity. Yet these may be insufficient. Systematic error may be quite reliable, and a high correlation between predictor and criterion may reflect the coincidence of related systematic error as much as the overlap of true effects. As writers in the personnel selection field noted long ago, we cannot safely assume the adequacy of the criterion and conclude that inadequacy lies only in the predictor. We might conceivably encounter a situation in which an excellent measure of supervisory support relates not at all to a measure of absenteeism which contains largely error.

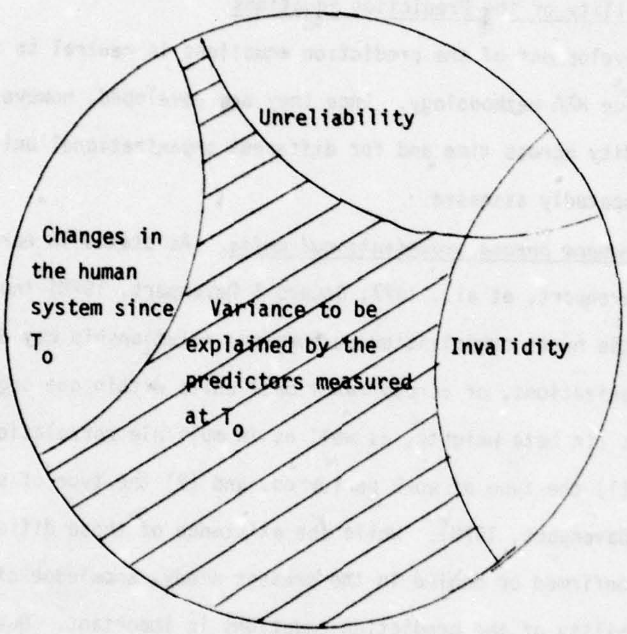
In any measure, criterion or predictor, the questions of reliability and validity arise. Lack of accuracy in performance data is not only a function of recording errors, but also inaccurate reporting or, perhaps, inappropriate data collection systems. While deliberate misrepresentation may not be a major problem in itself, coupled with other error sources, the result is performance measurements with far less than perfect reliability.

Thus, the strength of the human organization-performance relationship will depend on the reliability and validity of both the predictor and criterion measures. In most cases, measures will not cover all the "real" variance and will, in addition, introduce some error. These factors will tend to place an upper limit on the (performance) variance available to be predicted.

Another factor affecting the relationship between the criterion (measured at time T_o+k) and the predictors (measured at time T_o) is the concurrent relationship between criterion and predictors at time T_o+k. In other words, the level of performance today is a function of the state of the human system, both today and the way that it was in the recent past. Any changes in the predictors since their measurement at T_o would influence performance today at T_o+k. A possible representation of the factors which affect criterion variability is given in Figure 6.

Thus, in this present study, R's of .50 -- good as they are by comparison to past work and reports -- appear to account for a minor fraction of variance in the performance measure. Yet, this prediction may be quite accurate in terms of the amount of "true" variance

Figure 6



CRITERION VARIANCE
at some time $T_o + k$

available to be predicted. If we use the hypothetical value of .80 to indicate the (1) reliability of the performance measures, (2) the validity of these measures, and (3) the magnitude of the "true" human organization → performance relationship, we would have .80x.80x.80, or .51 as the "upper limit" of R. In other words, we might be predicting all there is to predict.

Generalizability of the Prediction Equations

The development of the prediction equations is central to the current-value HRA methodology. Once they are developed, however, their validity across time and for different organizational units must be repeatedly assessed.

Differences across organizational units. As stated in earlier reports (Davenport, et al., 1977; Bowers & Davenport, 1978) the nature of the human organization-performance relationship may differ across organizations, or across functional units within one organization. Differences (in beta weights, as well as in multiple correlations) may be due to (1) the type of work performed, and (2) the type of system (Bowers & Davenport, 1978). While the existence of these differences were not confirmed or denied in the present study, knowledge of the generalizability of the prediction equations is important. Questions like the following need answers:

- Would using separate prediction equations for manufacturing and, for example, accounting units result in better predictions?
- Would different equations for large, labor-intensive units and small capital-intensive units result in better predictions?

- Would better predictions be made by using separate equations for organizational units with generally participative management practices and those with authoritarian management practices?

An investigation of these questions requires a large number of units from either (1) several types of organizations or (2) diverse functional units within one organization. In most single organizations there are two or more functional areas. However, few of these areas are comprised of adequate numbers of units to develop equations for each of them separately. Such an organization would be faced with one of three choices: (1) use the same prediction equation for all task/system areas, (2) not include some units in the HRA system, or (3) use a prediction equation developed for the same generic area (e.g., accounting departments) based on data from several organizations.

Consistency across time. Regardless of how the prediction equations are developed, consistency of the human organization-performance relationships over time is a concern. That is, if the relationship changes from the period from which it was developed to the time period to which it is to be applied, the accuracy of prediction will decrease.

In an earlier chapter (Chapter 3) some potential causes of changes in the predictor-criterion relationships between predictor measurements were listed. Changes in business and economic conditions external to the organization, and growth or structural changes internal to the organization were two categories of these factors.

One technique for developing the prediction equation:

(1) $$\Delta\hat{Y} = B\Delta X$$

would be to have full, two year data on both performance (Y) and SOO (X). Then, by forming ΔX and ΔY values, estimate B. Even so, to evaluate the consistency of this relationship, one would need comparable data over several years, and preferably for several organizations.

In the present study, two year data were not available. Thus, the above procedure was not feasible in deriving equation (1). The alternative was to derive:

(2) $\hat{Y}_1 = B_1 X_1$

and then assume that $B_1 = B_2$, yielding

(3) $\hat{Y}_2 = B_1 X_2$.

By simple arithmetic, it follows that:

(4) $\Delta \hat{Y} = \hat{Y}_2 - Y_1 = Y = B_1 \Delta X$.

In this situation, the requirement of consistency of the relationship across time is even more evident.

Lapointe, et al. (1978), looked at the assumption of B=B with the very minimal data available within this study. They found no substantial evidence to support or invalidate this assumption. Change in the B's between predictor measurements, if it were established, would result in loss of accuracy in prediction.

Many researchers point to an additional reason why betas might be unstable over time -- multicollinearity (e.g., Rockwell, 1975). Multicollinearity implies that one or more of the predictor variables is a linear function (i.e., highly correlated) with other predictor variables. Interdependence of predictor variables is said to increase the variability of the estimates of the true regression weights -- i.e., the standard errors of b_1, b_2,...,b_{13}. As inter-correlations increase,

the beta values may become less reliable, which would reduce the likelihood that the same betas will be found for two prediction equations computed from comparable samples.

Lack of reliability in the estimates of the beta-weights (regression coefficients) resulting from high levels of multicollinearity would make it virtually impossible to test consistency of the criteria-predictor relationship over time. That is, if $\underline{B}_i$, i=1,2 represent two different sets of regression coefficients for two different time periods, as identified above, the equality of $\underline{B}_1 = B_2$ is a concern. Any attempt to test this null hypothesis with highly multicollinear data would almost guarantee rejection, regardless of its validity.

An investigation of multicollinearity of the data set used in the present study, following the suggestions of Rockwell (1975), revealed that the set of 13 SOO predictors were highly multicollinear. *On the other hand, the standard errors of the betas were small (Mean =* .20, SD = .02), and the betas for two random subsamples appeared similar. These findings indicated that, while the predictors were inter-correlated, this did not produce the troublesome effects often associated with multicollinearity. (For a more detailed discussion see Bowers & Davenport, 1978, Appendix A.) Thus, multicollinearity may not have been a problem.

Part Two
Design Issues

The basic issues of predictive strength and generalizability of the FPTI equations, that were discussed in Part One, have implications for the design of current-value HRA systems. The key design issues are the following:

A. What is the optimal number and type of predictors that should be included in the prediction equations?

B. How should the criterion variables be defined?

- What measures of performance are meaningful for different hierarchical levels and for different functional areas?
- When the criterion measure involves comparing actual performance to some standard, what effects will changing standards have on the accuracy of prediction?
- Is it meaningful to apply discounting and capitalization in cases when anticipated performance cannot be expressed in dollars?

C. What are the theoretical and practical implications of conducting the FPTI analyses at e.g., the work group versus the command level?

- What level of analysis will provide the most meaningful data?
- Can we expect to obtain the same relationships at different levels of analysis?

Predictor Variables

One concern which affects several aspects of the FPTI methodology is the number of predictor variables involved. In the present situation, 13 SOO indexes were used. In further investigation and application of FPTI, two questions arise: (1) Are there other aspects of the human system which ought to be measured and included in the prediction equations? (2) Is there an acceptable way to reduce the number of predictor variables?

The two, if both answered in the affirmative, appear to be in competition with each other. It may be however, that a good solution to the latter would negate, and possibly even be enhanced by any increases resulting from the former.

The present version of the SOO has 16 major indexes. Three of these were not used in the present study because they were either missing from some organizations or insufficiently reliable. However, as this line of inquiry continues, it may demonstrate that aspects of the human system, presently unrepresented by the SOO, relate strongly to criterion measures. Possible examples of such aspects include inter-unit coordination, job complexity, bureaucracy, and goal integration.*

The above discussion is somewhat reminiscent of the concerns introduced by Davenport et al. (1977), regarding modifier variables. The purpose of human resource accounting is to measure the state of

*Goal integration is currently included in the SOO so that its relationship to other SOO indexes can be investigated. Goal integration measures the fit between individual goals and organizational objectives.

the human system, so that its impact on performance can be investigated and reported. Thus, one criteria for inclusion of variables is that the variable measure some aspect of the human system. The inclusion of modifiers which increase the accuracy of prediction (such as structural or technical aspects of the organization) is acceptable provided that predicted changes are not due to changes in these modifiers, but to real change in the human organization.

In an effort to decrease the number of predictors, Lapointe et al. (1978), investigated excluding some of the 13 SOO predictor variables used in this study. The results indicated no single variable which should be excluded from all time period predictions. A modification of this approach might be of interest, however: Are there subsets of the predictors which could be used in different time periods?

In future research, one might demonstrate the existence of subsets of SOO indexes which have maximum effect on productivity in three time frames, say, 0 to 3 months, 4 to 8 months, and 9 to 18 months. If this is found, and the subsets include 7 or 8 variables, the resulting reduction in the number of predictors would significantly reduce the number of cases needed to achieve significant results.

While such a question appears fairly straightforward, the actual determination of these subsets of predictor variables would be quite complex. In addition to the definition of appropriate time frames, questions like, "Are the subsets criterion dependent?", would also need to be answered. Nevertheless, the concept is theoretically consistent and desirable in application, and ought to be investigated.

Criterion Variables

The criteria of organizational effectiveness considered important vary across systems. In the Navy, operational readiness and reenlistment rate are two valued outcomes. Most civilian organizations collect and monitor data on some aspects of productivity and absenteeism. Whatever variables are chosen, their validity/reliability, "variable" versus "fixed" nature, convertibility to dollars (or some other valued unit) are crucial factors.

Performance data are collected periodically, often daily. These data may then be aggregated into periods of longer duration. In this study, performance periods for the civilian sites were allowed to vary in length both within and across the organizations. Defining periods more uniformly would have the advantages of clear interpretation, especially in the context of accounting systems.

Defining performance for different organizational areas. Another issue of importance is the applicability and availability of performance measures for different functional units and hierarchical levels in an organization. For example, absenteeism is a measure that can probably be applied to all organization members, even though the cost of one day of absence will vary according to the level and function of the person absent as will the availability of accurate data regarding absence.

A measure like productive output, on the other hand, seems most applicable to those directly producing, i.e., to bottom-level line units. It can be applied to others only by some arbitrary rule of extrapolation. For example, the productive output of a group of commanders might be defined as equal to the average output of the groups in their domain.

One cannot safely extrapolate performance outside units, however, to staff units from a parallel operational unit, for example. One way of estimating performance of staff units would be to work simultaneously with an adequate number of organizations and their component units. Then, one could calculate increments and decrements in performance for each organization as a whole, and for the sum of the component units with performance measures available. The difference between these two calculations for a single organization might reflect, in part, the contributions of the staff areas. However, the same difference might also reflect the non-additive effects [illegible]he performance of the several component units, and the effects of aggregating performance data differently (i.e., to the cost-center versus the organizational levels). An alternative to extrapolation would be the development of new measures suitable for staff functions. While difficult, this alternative seems preferable.

The effects of changing performance standards. Other than in pure mathematics, numbers in their own right have no meaning. This is particularly true when the numbers represent measures of human behavior, or of system performance. For example, when a questionnaire is used to assess human behavior in an organizational setting, we begin with raw responses and work toward various aggregate or transformed measures. The raw responses of each member of a particular organizational work group may be converted to index scores by calculating a mean of component items. This mean then represents a central tendency of item responses for that particular individual in that index area. Taking a next step, we represent the whole work group by calculating a mean of individual index scores for the persons making up the group.

Now the score represents the central tendency of group members. In each of these instances, we have transformed the measures and given them a somewhat different meaning.

Interpreting these numbers may lead to additional steps, however. First, we may simply relate each group mean to the wording of the original response alternatives. If we do, our expectation is that a mean score reflects the meaning implicit in the wording of the alternative(s) closest to it.

This also may be inadequate, however, and we may choose to convert each score to a z-score, which states the score in terms of the dispersion of the scores in the sample. Finally, we might decide to convert each score to percentile form, either on the basis of our expectation derived from its z-score, or on the basis of an actual arraying of scores themselves. In both of these instances we have restated the score in terms derived from an expectation of some sort. The purpose is to transform the score to a form which has currency in an organization.

In systems theory terms, what this exemplifies is the transducer function -- the conversion of information to a form in which it can be circulated, interpreted, understood, and used elsewhere. By using performance standards, outcomes from various subunits within an organization can be compared. Thus standards are one method of converting information to a form in which it can be easily interpreted and used.

The process is relevant to the performance or criterion side of the relationships discussed and studied in this project. Total

variable expense, for example, has been defined in terms of "engineered standards." Initially in dollar form, expenses were restated as a percentage of some base, also calculated in dollars. These standards are often historically based and reflect in part the capacity of whatever equipment may be used. Beyond this, they reflect what has been experienced in the past for product mixes of particular kinds. An aggregation of the past thus becomes an expectation for similar situations or mixes in the future, and present experience is converted from raw "counting" form to a percentage of that expectation.

When, as in this project, performance is measured in terms of "engineered" historical standards, problems may arise in predicting future performance if the standards change between the time the equation is generated and the time future performance occurs. Such standards are changed periodically to take account of technological changes, changes in work mix, and the like. For example, assume that future performance predictions in a garment plant are made on the basis of equations using performance measures computed in terms of present or past standards. Such standards might assume five styles of four particular garmets, each in a dozen colors. They would also be determined by crew size in relation to existing equipment and its capacity. Future value is, accordingly, determined in terms of a base using that performance capacity. However, suppose that the company decides to produce, for a mass market, only one style of one garment in six colors, and that it brings in faster sewing machines and cuts crew size. Costs for a given volume of productive output will now be lower, and anticipated cost performances from improvement in the human organization must be calculated in terms of a "tighter" base.

In any ongoing current value system of human resources accounting, it would be wise to check continually the accuracy of prediction equations for revised-standard situations, and to update and change them accordingly.

The easy interpretation of such information outside the organization's boundary is less easy, however, even when historical standards are employed. The reason is that the means or methods used in determining standards may vary widely from organization to organization and from one time to another. This was one persuasive reason for the "dollar criterion" given by Brogden & Taylor (1950), and it is an equally persuasive reason for current value human resources accounting. In its normal or usual form, current value HRA not only anticipates future value, it also converts those changes into a metric with currency in a present time frame across organizational boundaries -- a dollar metric.

In this sense, current value human resources accounting is an organizational example of an output transducer. As such, its role is clear: the conversion of performance information into a form which can be circulated and understood by important role occupants in other, sometimes superordinate, entities.

The value attribution process in current value HRA carries this a step further, by the three-step sequence of (a) converting the added value back to dollar form, (b) discounting it to reflect opportunity costs, and then (c) capitalizing it in order to reflect is investment value.

Thus, in constructing a current value HRA system, we begin by calculating predictive equations, using criterion values derived from ratios of actual dollars expended to a then-current standard of expected dollars. We converted to anticipated gains and losses by removing the denominator -- the base or standard. However, if standards are changed between the time that the equation was generated and the time for which prediction was made, there are problems. The values to be realized from gains and losses in that future period (now presumably arrived at) are different from those that would have occurred had old procedures, old standards, and old values remained in effect. Stated in transducer terms, the values have been converted to a form that is either no longer capable of being circulated, or is, more likely, misleading.

Alternatives to the dollar metric. As we turn to the development of a current value human resources accounting system for the Navy, we need to remind ourselves that the procedure, not necessarily the dollar metric, is the critical issue. In industry, current value HRA calculates in dollar terms because dollars are the measurement unit used by profit-making enterprises and those policy of decision-makers who direct or influence them. Even here, other measurement units might be possible, however. Developments at a societal level suggest that the years ahead may well see the development of "quality of life," or "social responsibility," or "the environment" as meaningful units.

Whatever the measurement unit, the purposes remain the same: to convert organizationally-added value into measurement units which have currency among members of the Navy's management subsystem and among

those external entities and agencies whose decisions are critical to the Navy (e.g., Congress). Certainly, some aspects of Navy performance are dollar-convertible. For example, the costs of attrition or of low retention rate in critical ratings are expressible in dollars. However, the ultimate criterion of Navy unit performance is not simply the retention of manpower at the lowest possible cost, but the defense of the nation, and the non-economic aspects of this criterion are not dollar-convertible, The cost of losing a war is only in small part economic, for example. Its social and political consequences might well be disastrous, in ways not calculable in dollars.

Perhaps the closest approximation to this ultimate non-economic criterion is readiness, defined as an ability to cope with any military contingency that might arise. As we have noted in earlier reports, work by Dunnette, et al., identifies readiness as one of three critical criterion domains (Dunnette, et al., 1973). It may be therefore, that current value human resources accounting in Navy settings must be cast in terms of something like "readiness units" that are the analogs of dollars in industrial organizations.

Such a unit would represent increments and decrements in preparedness. The function of a current value system would be to anticipate changes in that readiness state that are attributable to improvement or deterioration in the human organization. Because it is a problem in anticipation, the analogs of capitalizing and discounting in commercial settings must be at least conceptualized, if not developed. Regardless of the metric, the purpose remains (a) to predict changes in outcomes, (b) to convert those changes into values on the metric

of relevant decision processes, and (c) to adjust the resulting figures for the impact of time.

In commercial organizations, one discounts to take account of opportunity costs -- that is, the value foregone by virtue of using assets for the investment being discounted. Similarly, one capitalizes to decide what kind of investment would normally be required to yield a return of the kind predicted or experienced. As stated, these are not thought of in symmetrical terms -- that is, one experiences opportunity costs, but never opportunity gains.

The whole notion of discounting is customarily stated in terms of desirable outcomes which must be awaited, and of alternative good things which must be foregone during the interim. The central concepts are that (a) the real increment is worth only the excess of its long-range positiveness over that of the most desirable interim alternatives, and (b) outcome, alternatives, and original investments are stated in the same terms. Among the perspectives not taken are (a) the added interim value of postponing a consequence into the future, and (b) situations in which either alternative outcomes or original investments are not stated in terms of the same metric as the discounted consequence.

The general question that discounting suggests is: Does delay add to or detract from the value of a future consequence? Is some value foregone because of its futurity? In the industrial case of dollar returns, the answer seems fairly clear: delay does detract from the value of an anticipated return, because of the alternative returns that one might have gotten in the meantime. In the case of the Navy, the answer is not so clear. Perhaps an ability to realize a substantial increment in readiness ten years hence adds to, rather than subtracts from, its present value -- it may well make unnecessary a

number of interim "patchings," discourage a potential aggressor who fears future retribution, etc.

Consider first the following example: In a Navy setting one could invest resources in an upgrading of the human organization that is expected to pay off in readiness terms in three to five years. Doing so diverts those same resources from alternative uses that might generate immediate readiness. <u>If immediate increments in readiness have positive value, then the investment can be discounted conventionally by some means</u>.

However, unlike dollars, additional units of readiness may not always be positive in value. For example, an immediate increase in readiness might cause a potential adversary to launch an attack, whereas future increments from a human organization investment might pay off handsomely at a critical time. In such a situation, one ought not <u>discount</u> (i.e., reduce) the value of future performance, but rather <u>augment</u> it.

Although less clear, a similar set of considerations might be applicable to capitalization. When capitalzing a return, commercial organizations address the question of how much by way of resources would have to be invested to realize a given level of return.

But in the military settings, one may not have to forego readiness now to realize a return later. Perhaps a present problem (cost) can be avoided or solved by the same investment that generates a future readiness return. For example, perhaps by upgrading the human resource processes of Navy units one can (a) immediately trim

attrition, enhance retention, and reduce disciplinary infraction, while (b) creating a set of conditions that will pay off in increased future readiness.

Again, the more general question is instructive: How much would one have to risk in readiness to attain a given increment in future readiness? For example, a series of actions might, if taken, have a high likelihood of adding significantly to future readiness. However, these actions might carry (a) risk of failure, and (b) some possibility of losing readiness altogether. Some improvements in future retention rates might cost severely in immediate readiness, or some improvements in future readiness might drive out all experienced personnel and generate severe discipline problems.

For both of these operations -- discounting and capitalization -- military analogs seem highly likely. The difference is that, unlike the comparatively simple operations which have been well worked through by the financial community using a dollar metric, the ties between present and future, investment and return, opportunities and their cost, have not yet been worked through for military organizations. Yet, those expert in related fields might well provide the needed guidelines.

Thus, the complete application of current value technology to Navy organizations in non-dollar-convertible sectors involves an answer to the questions just explored about a readiness metric. The task is large but not impossible. Furthermore, it may pay dividends outside

the area of predicting and interpreting future performance. It may well permit an analysis of policy implications of different readiness states that is not presently possible.

In spite of this remaining set of issues, limitations upon costing future changes into a proper present framework need not prevent taking the more basic steps of present value HRA for the Navy -- estimating future performance returns from present organizational changes in functioning and management.

Level of Analysis

Conceptually, human resource accounting techniques could be developed using any of the following as the unit of analysis: individual, work group, cost center, department, division, or organization. By unit of analysis, we mean the unit or level at which both performance and the quality of the human system is assessed. This section explores issues, both theoretical and statistical, which relate to the unit selection and also discusses the procedures used in our development of the FPTI methodology.

There are three major components which optimally get integrated when selecting the unit of analysis for a HRA system. The first is a theory of organizational functioning which is conceptually sound and appropriate to the organization at hand. One such theory is that of Rensis Likert (1961, 1967) which involves overlapping work groups, each supervisor being part of two work groups: the one which he or she supervises, and the one composed of all those reporting to his or her supervisor. This conceptualization of organizations has been rigorously examined and shown to be appropriate for a wide variety of organizations.

Some organizations do not fit the above model, however. One example is the matrix organization. The authors are aware, also,. of a particular municipal transit organization where 90% of the employees have no supervisor as such, and no substructure among themselves.

In these two cases, it would be important to develop a model of organizational functioning consistent with their structures. As has been noted by Pecorella and Bowers (1976), one major criteria for developing FPTI is the ability to measure relevant aspects of the human system. The selection of these dimensions is clearly related to having an appropriate model of organizational functioning.

This leads to the second of the three major components: the instrument used to measure the human system. The instrument must be consistent with the theoretical model discussed above. A specific facet of this consistency is the unit of analysis. For example, if the theory presumes the individual employee is the basic unit, then it is necessary that the instrument measure aspects of organizational functioning at the individual level. One subtlety in selecting "off-the-shelf" surveys is ensuring the fit of the theory base of the instrument and the appropriate organizational theory.

The third aspect which needs to be integrated with the first two, is how performance is measured. Performance may be measured at several levels of aggregation. Sometimes it is possible to measure it at the lowest level -- i.e., the individual. One such example would be absenteeism. However, at other times, it may be difficult to assign a performance score to each individual. Two alternatives exist in such circumstances: impute aggregated values to the desired unit (e.g.,

individual), or devise new performance measures which can be enumerated at the desired level. As discussed later in this section, the former frequently leads to statistical complications.

The level at which performance is measured does not have to be at the same level analysis as the theory or organizational functioning and the level at which the human system is measured. However, as discussed later, the continuity across all three is the most desirable state. Aggregation or imputation can cause errors in interpretation and precision.

Ecological fallacy. The ecological fallacy refers to the fact that events at one level of analysis may move in different directions from those at another level. Let us consider this process in terms of a question much discussed in recent years: Do more participative management practices result in a stronger reenlistment intention? Theoretically, human resource-oriented practices may be seen as having quite different effects at the individual, group, and organization level. For example, one investigator may find little or no relationship between the strength of these practices and the attitudes of Navy personnel at the individual level. However, another investigator might take the same data, correlate the two variables at the work group level, and find that participative practices result in a lower intention to reenlist. Yet, another investigator might decide that only whole organizational units -- e.g., ships -- are sensible units of analysis and therefore correlate organizational means for these variables. In this case, his conclusion would be that participative practices result in higher intentions to reenlist.

Although termed the "ecological fallacy," the situation may represent nothing fallacious at all. Each effect may be very real. Effects not present for individuals may be present for meaningful groups of those individuals. Groups, in their turn, may be clustered in a way that produces opposite effects when aggregated into cost-centers or commands. A crucial requirement is to determine as accurately as possible which effects are casual in nature and represent potential action variables (i.e., "handles" on the observed problem) and which are only the result of subsetting.

Effects of Imputation. As discussed by Pecorella and Bowers (1976), the data set on which the present series is based includes performance measures by cost center. The Survey of Organizations, used to measure the human system, collects data by work group. Because of the sample size necessary to do the multiple regressions involved, the cost center scores were imputed to the work group rather than aggregating the work group scores to the cost center. (In this setting, a cost center is a budgetary unit, with known predicted costs and performance.) The purpose of this section is to discuss the implications of imputation from cost center to work group. These remarks are made in addition to, not instead of, the comments above regarding the ecological fallacy.

As mentioned above, in the present study, it was necessary to impute cost center performance values to work groups. In the development of the statistical relationship between the human system and performance, the effect of the imputation of cost center values to work groups was to decrease the variance between work groups. The resulting multiple correlations were reduced, as was the accuracy of the computed prediction equations. Also implicit in this imputation

was that the contribution to the cost center was uniform across work groups. As discussed below, this may not be the case.

In the present study, once the prediction equations were obtained, future work group values were predicted from the corresponding change in work group human system values. In order to do the value attribution, work group-predicted performance values were returned to the cost center level. This was accomplished by taking the arithmetic average (mean) of the performance changes of the cost center's component work groups. Implicit in such a calculation is that the contribution of the component work groups is equal. This may not be the case. Take, for example, the situation in which a cost center is made up of nine work groups (say, three per shift) and one supervisory work group. Most organizational theorists would claim that the impact of the supervisory work group is significantly more important than that of any of the non-supervisory work groups. Thus, a change in the supervisory work group ought to predict more than one-tenth of the total cost center change. Another example might be in a cost center comprised of three work groups with 10, 5, and 4 employees. It is likely that a change in the larger work group will have more impact on the cost center than comparable changes in either of the other two work groups. (The situation in this second example could be handled through the use of a weighted mean, if, in fact, the work groups are not interdependent.)

Even if the number of cost centers available in the present data set had been sufficiently large to calculate reliable statistical relationships between performance measures and the <u>SOO</u>, it may not have been wise to do so. If the cost center became the unit of

analysis, then work group scores would be aggregated to the cost center. In many settings, such aggregation, usually done using weighted means, makes sense theoretically. For example, an organization may have 40 district offices, composed of three to seven work groups. In this situation, computing a district office score as an average of the component work groups provides a measure of the district office's overall quality. The obvious interdependency of the work groups is the justification for the aggregation.

However, in some cost centers, the component work groups may be independent. Consider, for example, the single work groups that staff a particular machine across the three shifts. Other than coordination of maintenance, it is conceivable that these work groups would have little interaction or interdependence. In a case like this, the aggregation of work group attributes to the cost center may not measure cost center attributes which relate to performance. That is, attributes of work groups which relate to their performance may not be generalizable to aggregates of independent work groups.

Another problem with aggregating work group scores to cost centers is not knowing how each work group should contribute to that aggregation. If, in fact, the exact contribution of each work group to performance were known, then the aggregated SOO scores could be combined using the same relative weighting. However, such knowledge is rarely available.

A final consideration of the consequences of imputation in the present study involves the examining of the accuracy of prediction. If a comparison is made between actual performance values and the predicted values, interpretation of the comparison is difficult.

If the scores compare favorably, there is no problem. If they do not, however, two interpretations are possible: First, the ability to predict may be low. Second, the process of aggregating predicted work group scores to the cost center level may be at fault, in which case the comparison is meaningless.

In summary, it is important that the organizational theory, the actual organization, the human system measurement device, and performance data measurement be integrated. The optimal solution is that this be done at the same level using the same unit of analysis.

Frequency of Data Collection

The frequency of data collection which is optimal may vary according to certain organizational characteristics, for example, the speed and frequency with which significant changes occur in the human organization and its performance. The purpose of this section is to discuss this and other issues related to designing measurement schedules.

Patterns of change. The human system, measured by the Survey of Organizations, changes over time. Little is known about the time framework in which those changes take place, or the expected duration of particular changes. However, both of these elements may affect FPTI.

As a first consideration, suppose a particular organization conducts measurement of the human system every 12 months. If, in fact, most human system changes occur frequently, but are short in duration, it would be possible to get work groups whose SOO scores show no change at the measurement points but, in fact, have significant variation within given years.

Clearly, it is important to know the life expectancy of human system changes. If the human system were monitored at time intervals less than this expected longevity, then the probablity of inaccuracies like those discussed above would be minimal.

The above illustration is a simplification of actual human system changes. At any one point in time, there may be several different changes going on in a particular work group. These may stem from external sources (change of personnel, task assignments, organizational structure) or internal sources (increased skill, peer interactions, personal tragedies). Thus, regardless of the life expectancy of any one change, several are apt to be starting and ending in overlapping patterns. The summative pattern would be the principle concern of further investigation.

Implicit in the above discussion is the assumption that cycles occur within the human system. This, in itself, is a question with different implications. One possibility is that there are no generalizable cycles, which makes concern about frequency of measurement a moot point.

One further concern raised by the present research, but not answerable given the constraints of the available data set, is the limit of future predictability. That is, how far into the future can we safely predict performance based on the quality of the human system today? Available evidence suggests a cycle of nearly two years, but it may even be longer. Organizational variables which may affect this include attribion, rotation policies, labor force growth, and demographic characteristics of the present labor force.

Another issue is the life expectancy of the performance changes. If, for example, a single unit improves in such a way that the resulting predicted performance change is valued at $5,000, how long does this value remain assigned to the work group? The FPTI methodology would predict this change for only one year, whereas, with no other changes in the human system, the saving could go on indefinitly. In many circumstances, the increased performance would be incorporated into new standards, which also obscures the lasting value of the change.

Structure-related considerations. Any real-world application of the current value method of human resources accounting employed in this present study would avoid the major problems of selecting a subset of work groups for value attribution purposes. Because all groups would be included and the necessary data built in as available from the start, little purposeful selection would be required.

Still, there would be some persisting aspects of the problem, attributable to such factors as structural changes which result in the disappearance of some units, the creation of others, and the serious modification of still others. For example, a situation could easily occur in which a unit, present at Time 1 and instrumental to the generating of the equations, disappeared before Time 2. In such an instance, predicting performance from Time 1 scores for such a unit would introduce distortion.

Similarly, where a new group is created by Time 2 which had no Time 1 counterpart, we might simply assign a Time 1 score corresponding to the class mean at Time 1 for all other scores with that same Time 2 value.

Still other changes result in the disappearance of units, but the persistence of their functions and former members. In such situations, one possibility is to use the unit's Time 1 scores and the old standards and make a prediction as if it still existed. The prediction would be added to the aggregation and presumably in some way reflect the persistence of its personnel and mission. However, this is not the preferred alternative. If new standards for the performance of the revised structure are available but not yet fully implemented, it would be better to wait and use them.

Finally, where reorganization results directly in changes in standards, one must adjust prior value increments accordingly. For example, a maintenance unit might be broken up and its personnel reassigned to operating units. In such an instance, some of its predicted future performance will now affect changes already predicted and valued for the units to which its personnel have gone. Those earlier predictions must accordingly be corrected.

Measurement issues. One question most organizations will have, if for no other reasons than logistics and cost, is "how often do we need to measure the human (social) system?" Discussed above is the issue of frequency of measurement with respect to the pattern, if any, of human system changes. Other factors affecting the frequency of measurement also need to be weighted when making this decision.

Clearly, measurement which is consistent with an organization's present accounting system would simplify integration of human resources accounting into the total accounting system. While, conceptually, it is possible to predict for different time frames than the periodicity of human system measurement, the complexity of statistical analyses

and developmental data base required would make such a program very difficult to develop. The one exception to that is if the frequency of measurement is some even multiple of the prediction period. (For example, predict for one year, but measure every two years).

Another problem develops, however, when one begins to predict for, say, the fourth year. If, in fact, it is now time T_3 and prediction for the fourth year is to be made, which data ought to be used? Possible solutions would include (a) T_3 data only, (b) T_2 data only, or (c) some combination of T_0, T_1, T_2 and T_3. At time T_3, the performance of the organization is a combination of the concurrent effects as given by the human system measurement at T_3 and all previous predictive effects (within the span of predictability discussed above). These effects are most likely not additive (i.e., not independent of each other).

The answer to this prediction problem (which data to include) is presently unknown. Research into the adequacy of the different possibilities is needed, but the inclusion of more than one year's data could assist in accurately predicting changes.

Summary

At the outset of this chapter, we listed five questions which pointed to remaining methodological issues. Each of these issues has now been discussed in some detail. The extent to which each question poses a problem for HRA was considered and some alternatives for handling them provided. The following conclusions seem warranted:

(1) While the amount of variance explained by FPTI predictors appears marginal, it may be that -- with the limited degree of accuracy achieved by current predictor and performance measures -- we are explaining most of the variance available to be explained.

(2) In the Navy, some outcome measures, such as operational readiness, are very significant, yet, cannot be expressed easily in dollars. Nevertheless, the concepts of discounting and capitalization are very relevant because they emphasize differences between the long and short-term consequences of decisions and strategies relating to readiness. This argues for developing analogues to commercial-world accounting notions which would apply in military settings.

(3) The variables that should and should not be included in a set of predictions for current value HRA must be specified, and should remain consistent across predictions for a given site. However, the predictors which are chosen will, optimally, provide a fit between the appropriate model of organizational functioning, the measurement instrument, and the particular organization under study.

(4) In organizations like the Navy where there is constant reorganization and turnover, there will be cases where predictions for particular units need to be adjusted and

and some time periods where no prediction can be made for a given unit. Some methods for handling these cases have been proposed in this chapter (& in the earlier report by Bowers & Davenport, 1978). Thus, especially in situations with large numbers of units, such cases do not constitute a great obstacle.

(5) The optimal frequency of data collection and reporting has not yet been specified. The considerations are both theoretical (e.g., what is the duration of human system qualities) and practical (e.g., what is the required time and cost of data collection) in nature. As more is learned about the frequency and extensiveness of changes in relevant variables in the organization, the optimal schedule can be designed, one which also fits the accounting considerations of the particular organization.

Thus, implementation of current value HRA will involve consideration and balancing of these methodological issues. The issues are complex, but manageable. Their appropriate resolution should add to the accuracy and usefulness of predictions made using the current value method.

CHAPTER 10

IS IT ETHICAL TO ACCOUNT FOR HUMAN RESOURCES?

Throughout this report, current-value human resources accounting has been advocated as a pervasive and useful management decision aid. Because of the potential power of HRA, however, it is essential to consider, in advance, the ethical issues raised by such an accounting system.

Two basic issues stand out: *First, is it ethical to place a monetary value on people?* A goal of current-value HRA has been to describe changes in the value of human resources in a unit, such as dollars, which is comparable to accounting figures for physical assets. The advantage of this is the increased awareness of the impact of management practices on the human organization (and thus on future performance). Many argue, however, that human resources are not comparable to physical assets and are dehumanized by the use of numeric terms, like dollars, to describe them.

Second, is the goal of HRA to improve profitability or to make the organization a better place to work? This question implies a conflict of interest between management and workers. Thus, it is basically

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an issue of control: What are the priorities of the organization? Who determines them? What happens when they come into conflict?

In the remainder of this chapter, we will discuss, in more detail, the questions raised by these two issues. In addition, some possible solutions will be offered.

Valuing Human Resources

Most researchers who argue that HRA is unethical, object to the idea of a "price tag" being placed on people. Perhaps the fear is that important qualities of people will be lost with a statistically-based accounting system like HRA. Sometimes the belief is that HRA *cannot* be done with acceptable accuracy. At other times the view is that it *should not* be done at all.

Comparing human assets to physical assets. One question is whether dollar figures from HRA can be equated to those for physical assets. Managers voice concerns like (a) HRA dollar figures are less accurate than figures associated with physical assets; (b) HRA figures are more difficult to audit -- i.e., to check -- for accuracy, and (c) decisions based on HRA figures affect people, not machines.

Yet, it is not certain that Points (a) to (c) above reflect the true picture. First, there are ambiguities in traditional accounting of physical assets. For example, what is a plant that cost $50,000 to build 20 years ago worth today? Should the original figure be adjusted for appreciation? What rate of appreciation should be applied? How often should the adjustment be made? These questions are not very different from those HRA is faced with.

In terms of checking the accuracy of accounting figures, both HRA and traditional accounting methods are dependent on having measures that are reliable and valid. The procedure and need for assessing the accuracy of production cost measures, for example, would be the same for both HRA and traditional accounting systems. Of course, the appropriateness of the FPTI prediction equations across time and organizational units needs to be evaluated regularly. This additional checking, however, reflects the fact that HRA attempts to account for additional variables.

The third concern -- that HRA describes people whereas traditional accounting describes machines and buildings -- is the most significant difference. However, it is important to recognize that decisions are made everyday which impact on people's working lives. Thus, the objection to "accounting" for people implies that HRA would foster decisions more injurious to those people.

Up to now, decisions regarding human resources have been based on managers' past experiences with similar cases, combined with their personal assessment of the current situation. Under this system, estimated costs of decision alternatives can be evaluated in terms of their effects on physical resources. Effects on human resources can only be guessed. Decisions based on such guesses include a great deal of error, because they are vulnerable to the misperceptions, preferences, and prejudices of the individual decision maker.

An HRA system, on the other hand, would provide additional input for evaluating decisions, vis-a-vis their likely impact on the value of the human organization. The descriptions of the human organization

would be based on multiple perceptions, rather than on one individual's view. It is probable that employees (as well as employers) would benefit from the increased objectivity and attention HRA provides.

In addition, HRA has the potential to introduce new variables into the list of desired outcomes and the human resource factors believed to determine these outcomes. Thus, it is possible that important changes will occur in organizational priorities. Such changes might increase the probability of organizational survival as well as improve the work situation of employees (Ross, 1978).

Avoiding dehumanization. The view that HRA should not be done relates to the concern that it will foster "dehumanization." The fear is that essential qualities of individuals will be lost by accounting for them in dollars.

Yet, in current accounting systems, the emphasis is totally on physical assets. This is significant because research has shown that managers attend more closely to areas that are measured (e.g., Anthony, 1970; Cammann, 1976; Likert, 1967; Thompson, 1967). Current value HRA might increase the consideration given to human resources utilization simply by measuring it.

In this regard, it is important to distinguish our concept of current-value HRA, which focuses on work group functioning, from other forms of HRA which attach dollar values to individuals. With a work-group-based accounting system, the emphasis is on how groups of people work together rather than on what one person does. The exception to this group focus is that particular managers might be held accountable for

changes in the value of groups they supervise. Of course, managers are already held accountable for the performance of groups under them. HRA would add accountability for the human resource variables affecting that performance. While some managers might view this change as limiting their freedom of action (Argyris, 1971), the additional information provided could also increase their ability to manage effectively (Likert, 1967).

Thus, it is not a case of HRA fostering dehumanization or not. Rather, concerns about accounting for human resources in dollars (or some other numeric limit) need to be weighed against the potential benefits of this accounting method for those same resources.

Issues of Control

The term "accounting" implies accounting "to" someone (Ross, 1978). Early human resources accounting efforts such as the one in R.G. Barry Corporation (1970) strove to include the HRA findings on the company's reports to stockholders. More recently, HRA has been emphasized as an internal management decision aid (Bowers & Pecorella, 1975; Mirvis & Lawler, 1977). These different orientations imply accounting to different parties -- e.g., accounting to stockholders versus accounting to management. The ethical issue becomes one of control -- how much control, by whom, and for whom. HRA theorists are beginning to address this issue more directly. Ross (1978) is now working to develop a social accounting system that would account to diverse interest groups (employees, management, stockholders, community, others). The accounting report would take different forms depending on the "stakeholder" being accounted to. In this type of system, control is shared.

Several "stakeholders" (to use Ross' term) could potentially be accounted to:

- organizational leaders responsible for the company's long-term survival,
- managers likely to be held responsible for the results suggested by HRA,
- employees of work groups whose functioning and motivations are actually being valued,
- stockholders who want to base their investments partly on information provided by HRA,
- citizen protection agencies who monitor treatment of workers and consumers,
- accountants and social researchers external to the organization who can provide theoretical and empirical support for including some measures and not others.

Ross (1978) views these stakeholders as having areas of common interests as well as areas of potential conflict. In the case of the current value HRA method described herein, the two most significant parties contributing to and affected by the system are organizational decision makers and non-supervisory employees.

The information provided by HRA to these stakeholders has important implications. Organizations routinely collect and retain information about their employees, such as their attendance and productivity. Issues of how much more and what kind of information will be collected are sensitive ones. The underlying concern is probably that the information will be misused.

Cammann (1976) discusses four potential uses of data systems like HRA would provide, to which we add a fifth:

(1) setting of performance goals,

(2) evaluation of employees,

(3) allocation of performance-contingent rewards,

(4) problem solving,

(5) cost-benefit analysis of development projects.

Decisions will need to be made regarding which uses are acceptable and unacceptable, and under what conditions this holds true. For example, Cammann (1976) found that when information systems were used by managers for evaluation and problem-solving (i.e., with the emphasis on development) subordinates responded positively and also increased their work-related effort. On the other hand, when the same information determined the rewards received, subordinates became more cautious and self-protecting. The response to using the data for goal-setting depended on whether the people affected by the goals had participated in setting them.

The above discussion indicates that an HRA system should be responsive to the concerns of significant stakeholders and that participation of these groups may be the best way to insure this responsiveness.

Conclusions

Ethical issues in HRA are basically issues of control. Thus, a simple "yes" or "no" vote for HRA misses the point. The ethics of HRA depend to a great degree on the system actually designed and implemented. Some guidelines can be suggested, however.

First, if an HRA system is to be "ethical" it should meet some criterion like "full and informed" consent. This is a criterion generally valued by social researchers. Second, the role relationships among the significant "stakeholders" should be clarified and the intended uses of the system agreed upon. These issues should be addressed from the early stages of development.

In addition to the ethical concerns discussed above, a poor HRA system (or a poor implementation) has two further costs: (1) resistance to the system which would result in loss of viability and possibly, failure of the system itself; and (2) the opportunity costs of having foregone alternative programs.

Thus, there are several strong forces for the careful design and implementation of current value HRA systems. These forces work in favor of HRA systems considered ethical by significant stakeholders.

SECTION V

SUMMARY AND CONCLUSIONS

Section V restates the major findings of the FPTI research conducted in both civilian and Navy settings. Results of statistical analyses from Sections II and III and the next steps suggested by the utilization issues discussed in Section IV are summarized briefly. The need for actual applications of current-value human resources accounting in organizations is emphasized.

CHAPTER 11

SUMMARY AND CONCLUSIONS

Current-value human resources accounting is intended to aid management in decision making. Its further goal is to provide information about the effects of organizational policies and practices on the value of organizations' human resources.

This report has summarized two phases of research activity. Phase 1 investigated the nature of the relationship between the human organization and organizational effectiveness. Phase 2, called value attribution, involved three steps: (1) the prediction of changes in performance, (2) the determination of the dollar value of these changes, and (3) the capitalization and discounting of these (future) dollar values.

These procedures were first applied to previously collected data from business and industry. Two performance measures, total variable expense (TVE) and absence rate (ABS), were predicted by the <u>Survey of Organizations</u> (Taylor & Bowers, 1972) measures, using equations developed via (double cross-validated) linear multiple regression. The following conclusions can be drawn from the analyses:

- There is evidence of both concurrent and predictive relationships of the Survey of Organizations' predictors to the criteria (TVE & ABS).

- As the theory underlying current-value human resources accounting predicts, the relationships with *future* performance periods (i.e., predictive relationships) are stronger than those with *concurrent* performance periods. The former relationships reach mean multiple R values of approximately .50, while the latter attain an average peak of slightly above .30. Similar patterns are displayed by both criterion measures, TVE, and ABS.

- A tentative conclusion was reached that the lag time period (from measured organizational functioning to the peak of its impact) is nine to 18 months. Consideration of the time from the likely onset of *organizational practices* to this same peak could extend the total cycle time to nearly two years.

- Value attribution procedures, together with capitalization and discounting, indicate that even small changes in the human organization can yield significant increments in future performance.

- Although a number of difficult questions remain, the findings clearly demonstrate that the behavioral resources for developing a current value system of human resources accounting in the civilian sector are available.

Second, the basis was laid for extension of current-value HRA to the Navy. Multivariate analyses showed significant relationships (in proportions far exceeding chance) between HRMS measures and Navy performance measures (operational readiness & reenlistment rate).

While the data necessary for completing the value attribution phase were not available, there was clearly evidence to merit further development of FPTI systems in the Navy.

Next Steps

The most essential next step is the design of current-value HRA systems for particular organizations. The methodology is now tested and "sturdy" enough to permit an experimental application. In fact, further development and refinement of FPTI rests on the shift from the use of data archives to data collections specifically designed for a current-value system of HRA. Of course, several issues remain and must be addressed -- for example:

- the number and nature of human organization predictors included in FPTI equations,
- the degree of multicollinearity (i.e., the extent to which predictors are correlated with one another),
- the frequency of measurements of both the human organization and performance variables,
- the meaningfulness of performance measures to organizational leaders and their convertibility into units (such as dollars) common and valued in the organizations,
- the appropriateness of prediction equations for different organizational units, especially when the units are different functionally and structurally,
- the stability of prediction equations from year to year.

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FORECASTING PERFORMANCE IN ORGANIZATIONS: AN APPLICATION OF CUR--ETC(U)
AUG 78 P A PECORELLA, D G BOWERS N00014-76-C-0362

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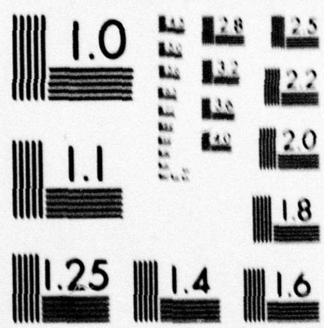

MICROCOPY RESOLUTION TEST CHART

Finally, it should be noted that HRA's acceptance and viability hinges as much on how it is used as on the quality of its design. A utilization study which investigates the FPTI system should accompany its application. Such a study would have two components: (1) the system itself (i.e., how it is refined, implemented, & adjusted), and (2) how FPTI systems affect organizational functioning.

In conclusion, well-designed, well-implemented current value HRA system can provide data about changes in the value of a too often overlooked sector of an organization -- its human resources. The presentation of this data in a unit common and valued in the organization will show more clearly the impact of management decisions on the human organization. HRA is also a potential tool for cost-benefit analyses, problem solving, performance evaluation, and other management duties currently so dependent on impressionistic data. Thus, while technical and implementation issues remain, accounting which for the impact of decisions on human resources will be a great deal more accurate than current systems that only account for physical resources.

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APPENDIX A

RELIABILITY OF <u>SOO</u> MEASURES

Table A-1

RELIABILITY OF SOO MEASURES:
MEAN AND RANGE OF ALPHA COEFFICIENTS
AND HOMOGENEITY RATIOS*

	Alpha Coefficients		Homogeneity Ratios	
	Mean	(Range)	Mean	(Range)
Organization I	.72	(.51-.86)	.58	(.26-.85)
Organization II	.87	(.71-.91)	.67	(.38-.86)
Organization III	..84	(.67-.94)	.65	(.41-.84)
Organization IV	94	(.78-.94)	.70	(.40-.88)
Organization VI	.85	(.72-.94)	.67	(.36-.85)

*These statistics were computed using group rather than individual data. The data were aggregated because all later analyses will also be conducted at the group level.

APPENDIX B

PERFORMANCE MEASURES:

DEFINITION OF MEASURES, DATA INCLUDED IN PERFORMANCE PERIODS, & INTERNAL CONSISTENCY OF PERFORMANCE PERIODS

Table B-1

MEASURES OF PERFORMANCE

ORGANIZATION		TVE1	ABS
I.	Title		Total Absence
	Definition		Number of employees absent in a month as percentage of total number of employees. (High Score = Poor Performance)
	Duration		Nov. 1965-Nov. 1967
II.	Title	% Production Efficiency	Absence Rate
	Definition	Actual manhours worked as percentage of budgeted manhours. (High Score = Poor Performance)	Number of mandays missed as a percentage of number of mandays scheduled. (High Score = Poor Performance)
	Duration	Jan. 1969-June 1970	Sept. 1969-May 1970
III.	Title	Overtime Labor Costs	Total Absence
	Definition	Total overtime as percentage of total scheduled work days. (High Score = Poor Performance)	Total days absent as per centage of total scheduled work days. (High Score = Poor Performance)
	Duration	Jan. 1968-April 1969	Jan. 1968-April 1969
IV.	Title	% Standard Cost	
	Definition	Variance of actual production costs from budgeted costs as a percentage of budgeted costs. (High Score = Poor Performance)	
	Duration	July 1969-March 1970	
VI.	Title	Total Variable Expense	Total Absence
	Definition	Largest actual expense figure from each cost center, encompassing all expenses, as a percentage of the budgeted figures for the cost centers. (High Score = Poor Performance)	Number of employees absent as percentage of the total number of employees.
	Duration	Nov. 1965-Aug. 1968	Nov. 1965-Sept. 1966

Table B-2

Total Variable Expense - Performance Periods for All Sites

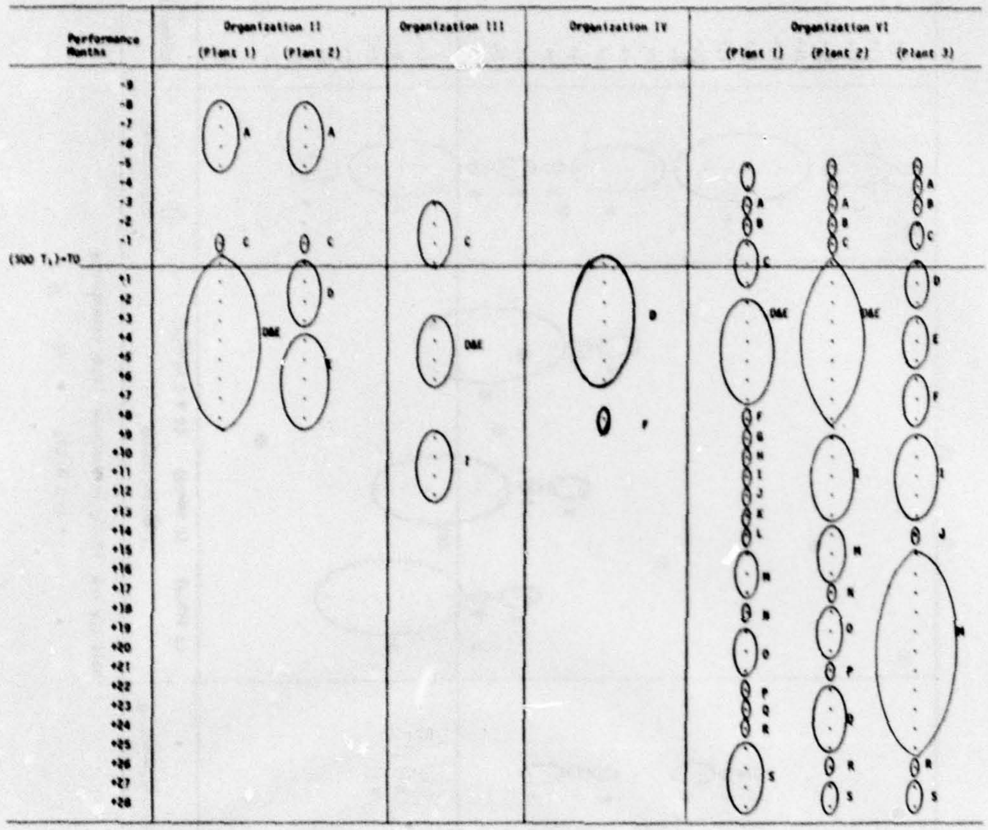

Table B-3

Absenteeism Rate - Performance Periods for All Sites

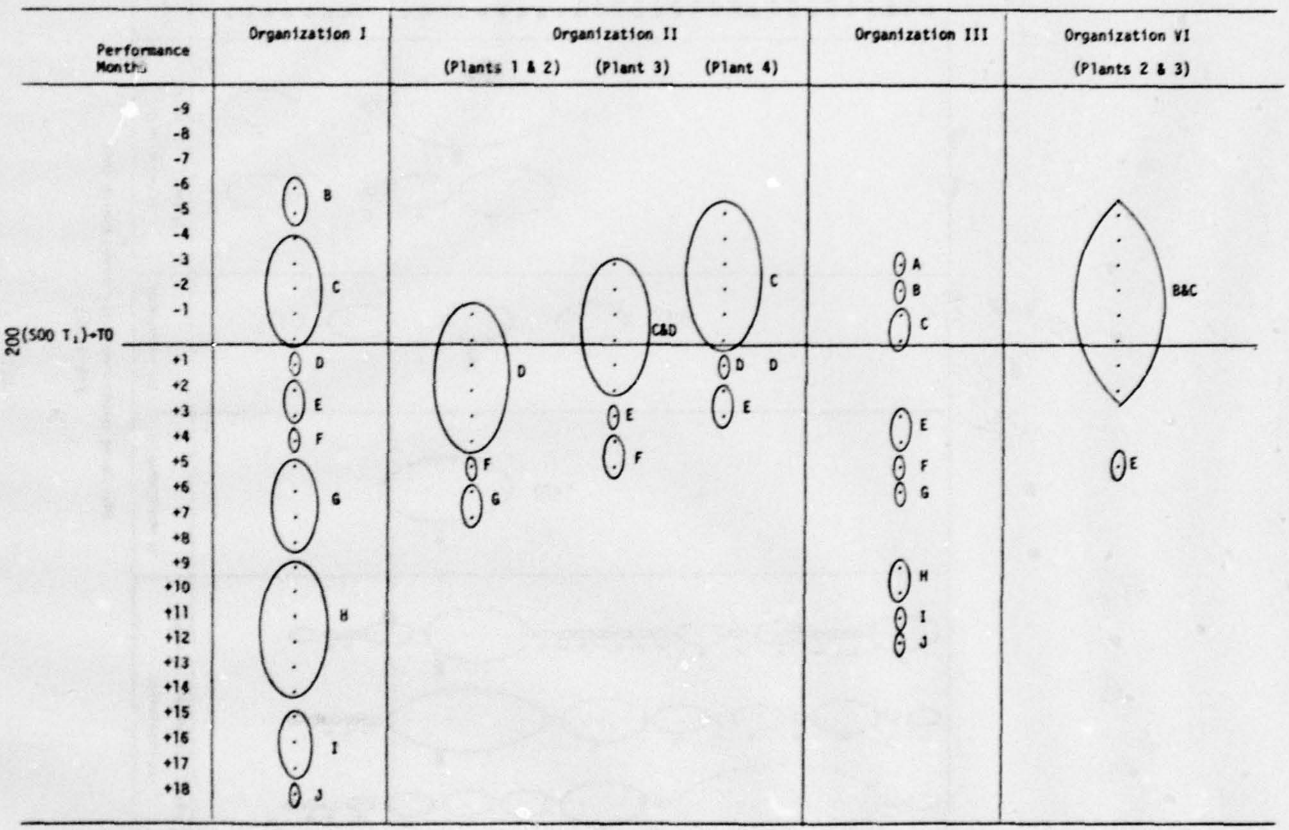

Table B-4

RELIABILITY OF PERFORMANCE PERIODS:

MEAN AND RANGE OF ALPHA COEFFICIENTS AND HOMOGENEITY RATIOS

	TVE				ABS			
	Alpha		HR		Alpha		HR	
	Mean	(Range Across Periods)	Mean	(Range Across Periods)	Mean	(Range Across Periods)	Mean	(Range Across Periods)
Organization I	--		--		.88	(.76-.97)	.75	(.62-.94)
Organization II	.92	(.83-.98)	.71	(.48-.93)	.92	(.55-.98)	.78	(.23-.96)
Organization III	.97	(.92-.98)	.89	(.77-.94)	.60	(.46-.74)	.49	(.38-.69)
Organization IV	.94	(.94)	.73	(.73)	--		--	
Organization VI	.89	(.67-.99)	.70	(.43-.99)	.90	(.90)	.90	(.90)

APPENDIX C

THE HUMAN ORGANIZATION-PERFORMANCE RELATIONSHIP:

DOUBLE CROSS-VALIDATION AND EXAMINATION OF THE RELATIONSHIP ACROSS TIME

Table C-1

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO TVE SUB-SAMPLES: SOO WAVE 1 INDEXES AS PREDICTORS

SOO T_1

	A	B	C	D	E	F	G	H	I
Sub-Sample 1									
R	.39	.39	.42	.32	.38	.47	too few cases to cross-validate		.29
N	92	64	219	254	219	100			201
p	.38	.77	.01	.01	.01	.04			.23
Sub-Sample 2									
R	.55	.42	.35	.25	.24	.45	too few cases to cross-validate		.37
N	96	63	223	255	223	98			208
p	.01	.64	.01	.22	.47	.08			.01
Cross-Val. R's									
Sub-sample 1 from sub-sample 2 weights	.30 p<.01	.23 p<.06	.22 p<.01	.23 p<.01	.21 p<.01	.16 p<.11	too few cases to cross-validate		.06 p<.33
Sub-sample 2 from sub-sample 1 weights	.42 p<.01	.23 p<.07	.24 p<.01	.18 p<.01	.13 p<.07	.20 p<.05			.11 p<.12

p = probability of obtaining this relationship with this number of cases by chance.

Table C-2

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO ABSENCE SUB-SAMPLES: SOO WAVE 1 INDEXES AS PREDICTORS

	A	B	C	D	E	F	G	H	I	J
Sub-Sample 1										
R	.52	.35	.43	.50	.23	.40	.38	.50	.58	.49
N	127	190	211	58	211	171	164	142	131	131
p	.01	.04	.01	.36	.64	.01	.03	.01	.01	.01
Sub-Sample 2										
R	.46	.30	.30	.55	.27	.30	.34	.46	.51	.39
N	127	199	224	37	224	147	139	135	135	135
p	.01	.16	.07	.69	.21	.44	.24-	.01	.01	.97
Cross-Val. R's										
Sub-sample 1 from sub-sample 2 weights	.44 p<.01	.25 p<.01	.28 p<.01	-.04 p<.74	.03 p<.65	.21 p<.01	.26 p<.01	.43 p<.01	.50 p<.01	.34 p<.01
Sub-sample 2 from sub-sample 1 weights	.40 p<.01	.21 p<.01	.20 p<.01	-.08 p<.65	.08 p<.21	.14 p<.10	.23 p<.01	.38 p<.01	.42 p<.01	.44 p<.01

Table C-3

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO TVE SUB-SAMPLES: <u>SOO</u> WAVE 2 INDEXES AS PREDICTORS

	A	B	C	D	E	F	G	H	I	SOO T_2
Sub-Sample 1										
R	.47	.56	.28	.35	.24	.37	too few cases to cross-validate		.23	
N	95	65	204	265	206	127			197	
p	.07	.06	.27	.01	.53	.16			.65	
Sub-Sample 2										
R	.34	.51	.31	.25	.36	.45	too few cases to cross-validate		.38	
N	93	65	204	261	203	125			195	
p	.67	.21	.10	.23	.01	.01			.01	
Cross-Val. R's										
Sub-sample 1 from sub-sample 2 weights	.06 p<.55	.23 p<.06	.09 p<.19	.18 p<.01	.04 p<.52	.18 p< 05	too few cases to cross-validate		.09 p<.20	
Sub-sample 2 from sub-sample 1 weights	.10 p<.37	.19 p<.14	.08 p<.26	.14 p<.02	.12 p<.09	.30 p<.01			.08 p<.26	

Table C-4

MULTIPLE REGRESSION AND CROSS-VALIDATION STATISTICS

FOR TWO ABSENCE SUB-SAMPLES: SOO WAVE 2 INDEXES AS PREDICTORS

	A	B	C	D	E	F	G	H	I	J
Sub-Sample 1										
R	.61	.39	.39	.35	.28	.36	.35	.52	.50	.52
N	111	182	190	50	190	157	159	145	135	135
p	.01	.01	.01	.96	.33	.09	.09	.01	.01	.01
Sub-Sample 2										
R	.64	.39	.42	.66	.42	.40	.37	.32	.52	.33
N	110	178	185	46	185	152	155	141	132	132
p	.01	.01	.01	.07	.01	.02	.05	.32	.01	.34
Cross-Val. R's										
Sub-sample 1 from sub-sample 2 weights	.52 p<.01	.22 p<.01	.34 p<.01	.15 p<.31	.05 p<.50	.20 p<.01	.11 p<.16	.28 p<.01	.42 p<.01	.23 p<.01
Sub-sample 2 from sub-sample 1 weights	.52 p<.01	.20 p<.01	.35 p<.01	.35 p<.02	.24 p<.01	.17 p<.04	.10 p<.20	.18 p<.03	.40 p<.01	.10 p<.25

Table G-5

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 1 SOO INDEXES AS PREDICTORS OF TVE

		TVE Periods									
		A	B	C	D	E	F	G	H	I	
Entire Sample											
	R	.46	.38	.34	.27	.27	.40	.57	.48	.26	
	N	188	127	442	509	442	198	51	51	409	
	p	.01	.16	.01	.01	.01	.01	.23	.58	.01	
		J	K	L	M	N	O	P	Q	R	S
	R	.28	.70	.57	.35	.38	.47	.37	.54	.35	.29
	N	124	51	51	186	79	79	79	49	108	108
	p	.76	.01	.22	.11	.59	.18	.69	.37	.43	.79

Table C-6

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 1 SOO INDEXES AS PREDICTORS OF ABSENCE

	A	B	C	D	E	F	G	H	I	J
Entire Sample										
R	.47	.30	.33	.34	.20	.32	.33	.43	.53	.43
N	254	389	435	128	435	351	290	290	266	266
p	.01	.01	.01	.33	.18	.01	.01	.01	.01	.01

Table C-7

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 2 SOO INDEXES AS PREDICTORS OF TVE

	A	B	C	D	E	F	G	H	I	
Entire Sample										
R	.26	.34	.23	.27	.21	.37	.55	.46	.18	
N	188	130	408	526	409	252	56	56	392	
p	.44	.31	.06	.01	.18	.01	.19	.57	.43	
	J	K	L	M	N	O	P	Q	R	S
R	.33	.50	.62	.35	.47	.42	.33	.59	.37	.39
N	129	56	56	159	87	87	81	52	117	120
p	.36	.41	.04	.11	.10	.30	.81	.14	.26	.14

Table C-8

MULTIPLE REGRESSION STATISTICS FOR THE ENTIRE SAMPLE:

WAVE 2 SOO INDEXES AS PREDICTORS OF ABSENCE

	ABS Periods									
	A	B	C	D	E	F	G	H	I	J
Entire Sample										
R	.59	.33	.39	.42	.30	.33	.28	.36	.49	.34
N	221	360	375	96	375	309	314	286	267	267
p	.01	.01	.01	.20	.01	.01	.02	.01	.01	.01

APPENDIX D

THE USE OF CHANGE SCORES

APPENDIX D

THE USE OF CHANGE SCORES

As indicated by previous conceptual discussions (Pecorella & Bowers, 1976a; Likert & Bowers, 1973), the current value methodology rests on the observation of change in causal predictor variables which is then used to estimate a future change in some criterion of employee or work group behavior. Attention to issues in the measurement and analysis of change has increased with its popularity. A change score is defined as the difference between two measurements of the same attribute taken at different points in time. Thus, in the present study $\Delta X = (X'-X)$ is a change score.

Cronback and Furby (1970) and Kessler (1977) both list four basic uses of change scores: (1) in the analysis of experimental data, (2) as criterion scores in correlational studies, (3) as indicators of theoretical constructs which cannot be measured directly , and (4) to identify exceptional individuals (Cronback & Furby, pg. 77). They do not, however, address themselves to the use of change scores as predictors of change in a criterion.

It is clear that the problems associated with the computation of change scores will exist regardless of their intended use. These problems center about two issues: (1) the reliability of change scores, and (2) the effects of "regression towards the mean."

The reliability of a change score is a function of its component score (the scores on the attribute at T_o and again at T_o') reliabilities (R_x & $R_{x'}$), and its component score intercorrelations ($r_{xx'}$).

$$R_{\Delta x} = \frac{VAR(X)R_x + VAR(X')R_{x'} - 2SD(X)SD(X')r_{xx'}}{VAR(X) + VAR(X') - 2SD(X)SD(X')r_{xx'}} \quad (1)$$

SD = standard deviation

VAR = variance

R = reliability

$r_{xx'}$ = Pearson product-moment correlation between X and Y´

These effects may be more easily seen if we assume that VAR(X)=VAR(X´), and $R_x=R_{x'}$ (Kessler, 1977). Doing so, equation (1) becomes equation (2).

$$R_{\Delta x} = \frac{2VAR(X)(R_x) - 2VAR(X)r_{xx'}}{2VAR(X) - 2VAR(X)r_{xx'}} = \frac{R_x - r_{xx'}}{1 - r_{xx'}} \quad (2)$$

From equation (2) we see that the upper limit of the change score reliability is the reliability of its component scores (if $R_x \neq R_{x'}$ then the larger of the two is the limit of $R_{\Delta x}$). This is not a surprising result since we would *hardly* expect the difference between two component scores to be more reliable than the most reliable of the component scores. Equation (2) also demonstrates that as the correlation between X and X´ ($r_{xx'}$) increases, the reliability of their observed difference decreases. This may be seen intuitively if one considers that when $r_{xx'}$ is very high, we would say that X and X´ are almost identical to each other. Any observed difference between two nearly identical quantities will reflect little more than measurement error. Since the difference is our change score, it follows than when $r_{xx'}$ is high, the change score reliability, $R_{\Delta x}$ will be low.

It is interesting to note a potential fallacy here. Test-retest reliability, which is a measure of stability over time, is perhaps the most common conception of component score reliability. Any attempt

to measure reliability in this manner while attempting to measure change results in conceptually (and often algebraically) equating R_x and $r_{xx'}$. This necessarily produces low change score reliabilities which can be attributed to low component score reliabilities (if $R_x = r_{xx'}$ is low) or to high component score intercorrelations (if $R_x = r_{xx'}$ is high). Thus, the reliability of the change scores will inevitably suffer if component score stability (the most common definition of reliability) and change are measured at the same time. The alternative, assuming a decision to use change scores, is to use a measure of reliability other than stability measured at the same time at which change is being measured. In the present study, R_x is measured by Cronbach's alpha, a measure of internal consistency. Thus, the potential fallacy described above is not of concern here. The change score reliabilities herein, reported in Table 1 along with component score reliabilities and intercorrelations, are necessarily a function of R_x, $R_{x'}$, and $r_{xx'}$. However, since the definition and computation of component score reliability (R_x,$R_{x'}$) is clearly distinct from that of component score stability over time ($r_{xx'}$), we are able to obtain generally high reliabilities for both the component and change scores. The figures reported in Table D-1 were computed for 797 work groups which have SOO measures available for T_0 and T_0'.

The second problem associated with gain scores is a "regression toward the mean" effect which produces a negative correlation between ΔX and X. Kessler (1977) describes three mechanisms by which this effect occurs and discusses the most popular correction for this the

Table D-1

SOO CHANGE SCORE RELIABILITIES[1]

INDEX	[2] R_x	[2] $R_{x'}$	[3] $r_{xx'}$	[4] $R_{\Delta x}$
Supervisory Support	.91	.93	.43	.86
Supervisory Goal Emphasis	.83	.89	.49	.73
Supervisory Work Facilitation	.90	.92	.44	.84
Supervisory Team Building	.91	.93	.49	.84
Peer Support	.85	.88	.33	.80
Peer Goal Emphasis	.80	.82	.36	.69
Peer Work Facilitation	.89	.88	.32	.83
Peer Interaction Facilitation	.89	.90	.35	.84
Human Resources Primacy	.91	.91	.69	.71
Communication Flow	.81	.86	.54	.64
Motivational Conditions	.80	.86	.59	.59
Decision Making Practices	.65	.88	.62	.36
Satisfaction	.84	.89	.51	.73

[1] Figures shown are for all work groups with SOO scores at T_o and T_o' (N=797)

[2] R_x and $R_{x'}$ are the alpha coefficients for SOO indices measured at T_o and T_o' respectively.

[3] $r_{xx'}$ is the inter-wave correlation of T_o and T_o' SOO index scores.

[4] $R_{\Delta x}$ is the reliability of the change score $\Delta X(=X'-X)$.

effect. Briefly, this correlation involves the use of the residuals of the gain scores after they have been regressed on the T_o component scores. Thus, the quantity $(\Delta X-\Delta\hat{X})$, where $\Delta\hat{X} = B_o + B X$, is used as a "residualized" gain score. Both Cronbach and Furby (1970), and Kessler (1977) argue that this correction is of limited or no use.

While the problems inherent in change score computation are fairly well known, their implications for the various uses of change scores are still being actively debated (Kessler, 1977). Furthermore, the debate centers on the four uses of change scores listed above and whether and how they should be corrected. To our knowledge the debate has not yet touched on change scores as used in the present study, i.e., as predictors in a regression equation developed from one wave of the component scores. Given this lack of guidance, our stragegy has been to use the raw or uncorrected gain scores $(\Delta X = X' - X)$ as opposed to applying one of the various "correction formulae." Our rationale for this is twofold: first, these correction formulae are shown to be of extremely limited use (Cronbach & Furby, 1970). Second, the current use of change scores does not fall into any of the previously examined purposes and there is no advantage in simply applying a correction formule without an explicit theoretical and/or statistical rationale.

APPENDIX E

FREQUENCY DISTRIBUTIONS OF RESIDUALS

Figure E-1

TVE PERIOD C

Histogram

```
Midpoint    Hist %       (Each x = 1)
-1.7102       .2     1   +x
-1.4602      0.      0   +
-1.2102       .7     3   +xxx
-.96020      3.2    14   +xxxxxxxxxxxxxx
-.71021     13.1    58   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
-.46021     16.7    74   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
-.21021     16.1    80   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .39769     13.3    59   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .28979     10.9    48   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .53979      9.3    41   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .78979      5.0    22   +xxxxxxxxxxxxxxxxxxxxxx
 1.0396      3.2    14   +xxxxxxxxxxxxxx
 1.2896      2.9    13   +xxxxxxxxxxxxx
 1.5396      2.5    11   +xxxxxxxxxxx
 1.5396       .7     3   +xxx
 1.7896       .2     1   +x               (Interval Width = .25000)
```

TVE PERIOD G

Histogram

```
Midpoint    Hist %       (Each x = 1)
-.61570      2.0     1   +x
-.36570     13.7     7   +xxxxxxx
-.11570     41.2    21   +xxxxxxxxxxxxxxxxxxxxx
 .13430     29.4    15   +xxxxxxxxxxxxxxx
 .38430      7.8     4   +xxxx
 .63430      3.9     2   +xx
 .88430      2.0     1   +x
                                          (Interval Width = .25000)
```

Figure E-2

ABS PERIOD A

Histogram

```
Midpoint   Hist %      (Each x = 1)
-2.1432     1.2    3   +xxx
-1.8932      .8    2   +xx
-1.6432     4.3   11   +xxxxxxxxxxx
-1.3932     2.4    6   +xxxxxx
-1.1432     5.9   15   +xxxxxxxxxxxxxxx
-.89323     5.9   15   +xxxxxxxxxxxxxxx
-.64323     8.3   21   +xxxxxxxxxxxxxxxxxxxxx
-.39323     8.7   22   +xxxxxxxxxxxxxxxxxxxxxx
-.14323    13.0   33   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .10677    13.8   35   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .35677     9.1   23   +xxxxxxxxxxxxxxxxxxxxxxx
 .60677     8.3   21   +xxxxxxxxxxxxxxxxxxxxx
 .85677     5.9   15   +xxxxxxxxxxxxxxx
 1.1068      .4    1   +x
 1.3568     3.1    8   +xxxxxxxx
 1.6068     3.1    8   +xxxxxxxx
 1.8568     2.0    5   +xxxxx
 2.1068     2.4    6   +xxxxxx
 2.3568      .8    2   +xx
 2.6068      .8    2   +xx               (Interval Width = .25000)
```

ABS PERIOD H

Histogram

```
Midpoint   Hist %      (Each x = 1)
-1.5548     1.4    4   +xxxx
-1.3048     2.1    6   +xxxxxx
-1.0548     3.5   10   +xxxxxxxxxx
-.80482     2.1    6   +xxxxxx
-.55482     7.6   22   +xxxxxxxxxxxxxxxxxxxxxx
-.30482     7.6   51   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
-.54623 -1 19.4   56   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .19518    18.0   52   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .44518    18.0   52   +xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
 .69518     6.9   20   +xxxxxxxxxxxxxxxxxxxx
 .94518     1.0    3   +xxx
1.1952      1.7    5   +xxxxx
1.4452       .3    1   +x
1.6952      0.     0   +
1.9452      0.     0   +
2.1952      0.     0   +
2.4452       .3    1   +x                (Interval Width = .25000)
```

APPENDIX F

CHARACTERISTICS OF DELETED DATA

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Table F-1

CHARACTERISTICS OF DELETED DATA

Criterion	Period	Criterion Standardized Score of Deleted Cost Centers[1]	Before Deletion		After Deletion	
			N	R	N	R
TVE	D	9.15	509	.25	505	.28
	H	7.79	51	.49	45	.57
ABS	C	7.13	435	.28	434	.31
	D	4.84 6.26	128	.39	121	.40
	E	-10.15	435	.26	434	.30
	H	6.9	290	.35	289	.42

[1]In all periods except ABS-D, only one cost center was eliminated. In ABS-D, two cost centers were eliminated.

APPENDIX G

MEANS, STANDARD DEVIATIONS, AND RELIABILITIES OF CHANGE SCORES ON 13 SOO INDEXES

Table G-1

MEANS, STANDARD DEVIATIONS AND RELIABILITIES

OF CHANGE SCORES ON 13 SOO INDICES

	TVE (N=507)		ABS (N=373)		TOTAL (N=797)		
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$R_{\Delta x}$
SOO Index							
Supervisory Support	.045	.664	.091	.651	.070	.679	.86
Supervisory Goal Emphasis	.046	.605	.099	.590	.080	.632	.73
Supervisory Work Facilitation	.134	.695	.187	.667	.182	.714	.84
Supervisory Team Building	.123	.749	.200	.734	.166	.782	.84
Peer Support	.008	.503	.043	.515	.019	.533	.80
Peer Goal Emphasis	.096	.551	.122	.536	.114	.582	.69
Peer Work Facilitation	.123	.606	.175	.598	.164	.644	.83
Peer Interaction Facilitation	.076	.660	.143	.650	.106	.699	.84
Human Resources Primacy	.048	.550	.576	.557	.047	.578	.71
Communication Flow	.110	.564	.166	.564	.125	.586	.64
Motivational Conditions	.006	.526	.051	.495	.024	.541	.59
Decision Making Practices	.085	.519	.102	.536	.089	.560	.36
Satisfaction	-.011	.498	.059	.473	.011	.520	.73

TVE = Statistics for work groups used to predict changes in TVE

ABS = Statistics for work groups used to predict changes in ABS

Total = Statistics for all work groups. $R_{\Delta x}$ is for all 797 work groups.

APPENDIX H

EQUATIONS FOR RETURNING PREDICTED CHANGES IN STANDARD SCORE FORM TO RAW SCORE FORM

EQUATIONS FOR RETURNING PREDICTED CHANGES IN STANDARD SCORE FORM TO RAW SCORE FORM

For the univariate case we have:

(1) If $Z_Y=\frac{Y-\bar{Y}}{SD_Y}$	Y = "Raw" criterion score
(2) and $\hat{Y}=B_0+BX$	B = Regression Coefficient used to estimate Y
(3) and $\hat{Z}_Y=B_{0_Z}+B_Z X$	B_Z = Regression Coefficient used to estimate Z_Y.
(4) then $\hat{Z}_Y=\frac{Y-\bar{Y}}{SD_Y}$	' = at or subsequent to wave 2 <u>SOO</u> measurement

(5) since $Z_Y'=B_{0_Z}+B_Z X'$ (assuming $B_{0_Z}=B_{0_Z}'$, and $B_Z=B_Z'$)

(6) and $\hat{Y}'=B_0+BX'$ (assuming $B_0=B_0'$ and $B=B'$)

(7) then $\hat{Z}_Y'=\frac{\hat{Y}'-\bar{Y}}{SD_Y}$

(8) since $\Delta\hat{Z}_Y=\hat{Z}_Y'-\hat{Z}_Y=\frac{\hat{Y}'-\bar{Y}}{SD_Y}-\frac{\hat{Y}-\bar{Y}}{SD_Y}$

(9) then $\Delta\hat{Z}_Y=\frac{\hat{Y}'-\hat{Y}}{SD_Y}=\frac{\Delta\hat{Y}}{SD_Y}$

(10) and $\Delta\hat{Y}=SD_Y\cdot\Delta\hat{Z}_Y$

Equation (1) is the formula whereby standardized or 'Z' scores are computed. (2) is the regression equation for the least squares estimate of Y, $\hat{Y}$. (3) is the regression equation for the computation of $\hat{Z}_Y$ where $\hat{Z}_Y$ is defined by the function shown in (4). (5) shows the prediction of a score, $\hat{Z}_Y'$, using a value of X' on the predictor and the parameters B_Z and B_{0_Z}. It is important to note that $\hat{Z}_Y'$ as computed in (5) is in

general not a true standard score. It will not have a mean of zero and standard deviation of one unless these parameters for X' are identical to those for X. (7) shows the relationship of $\hat{z}_Y$' to $\hat{Y}$' when $\hat{Y}$' is computed as shown in (6).* (8) is a definition of $\hat{z}_Y$, which by algebraic manipulation becomes (9). Finally, the transformation of $\Delta\hat{\underline{z}}_Y$ to $\Delta\hat{Y}$ is shown in (10). Again, $\Delta\hat{z}_Y$ is not a standard score but the difference between two scores which are linear transformation of "raw" predicted scores.

The predicted change scores were in the <u>form</u> of $\Delta\hat{z}_Y$ scores and had to be converted to $\Delta\hat{Y}$ form. This is done by equation (10). Since this original standardization was accomplished within organizations, the value of SD_Y is different for each organization. These values of SD_Y are shown in Table A-1

---

*The effect of standardization within organizations (use of different SD_Y) on the multiple R's was discussed by Davenport, et al. (1977). There is a similar effect here on the relationship of $\hat{z}_Y$' to $\hat{Y}$' so that (7) is only an estimation of the actual relationship. The findings in Davenport et al. (1977) indicate that the effect is small, however, and therefore (7) has been used as it stands.

Table H-1

STANDARD DEVIATIONS OF TVE AND ABS SCORES
USED TO CONVERT PREDICTED SCORES FROM
STANDARD SCORE FORM TO RAW SCORE FORM

	TVE	ABS
ORG I	---	2.49
ORG II	2.99	4.79
ORG III	5.46	2.93
ORG IV	1.52	---
ORG VI		
Plant 1	0.24	---
Plant 2	0.36	4.00
Plant 3	1.95	2.81

APPENDIX I

EFFECTS OF TREATING LABOR-COST-BASED TVE MEASURES AS STANDARD-DOLLAR-BASED MEASURES ON ESTIMATES OF ACTUAL DOLLARS

APPENDIX I

The treatment of the TVE measures from Organizations II and III as though they were total rather than labor costs influenced our predicted cost savings. Figure I-1 compares the result of multiplying the ratio of actual labor costs (ALC) to scheduled labor costs (SLC), by (1) Standard Dollars (SD) (the denominator from TVE for Organizations IV & VI) to the result of multiplying (2) by scheduled labor costs. We are concerned with three possible situations: the labor cost ratio (ALC/SLC) is smaller than the dollar ratio (AD/SD), equal to, or larger than the dollar ratio. As shown in the first column, multiplication of the labor cost ratio by scheduled labor cost always yields a product, X, equal to actual labor cost which must be smaller than actual dollars. Column 2 shows that multiplication of the labor cost ratio by the Standard Dollar yields a product, X, that is in all cases larger than the actual labor cost and in two cases less than or equal to the actual dollars. Clearly in these two cases (cells 2 & 4) multiplication of the ALC/SLC ratio by SD yields a more accurate estimate of AD than does multiplication by SLC. In the third case (cell 6) the result of multiplying the labor ratio by SD is larger than ALC and AD. Whether AD is closer to ALC or to the product of the multiplication (X) will depend on the actual figures. Thus in at least two of the three possible situations, multiplication of the labor ratio by the standard dollars, as done in the present value attribution illustration, will increase the accuracy of the estimates of actual dollars. As was noted previously, the principle is the same whether we are estimating actual dollars, predicted actual dollars or predicted change in actual dollars.

Table I-1

EFFECT OF TREATMENT OF LABOR-COST-BASED
TVE MEASURES AS STANDARD-DOLLAR-BASED TVE MEASURES
ON ESTIMATES OF ACTUAL DOLLARS

Relation of $\frac{ALC}{SLC}$ to $\frac{AD}{SD}$:	$\frac{ALC}{SLC}$ MULTIPLIED BY: SLC	SD
$\frac{ALC}{SLC} < \frac{AD}{SD}$	Cell 1 ALC = X < AD	Cell 2 ALC < X < AD
$\frac{ALC}{SLC} = \frac{AD}{SD}$	Cell 3 ALC = X < AD	Cell 4 ALC < X = AD
$\frac{ALC}{SLC} > \frac{AD}{SD}$	Cell 5 ALC = X < AD	Cell 6 ALC < AD < X

ALC = Actual Labor Costs

SLC = Scheduled Labor Costs

AD = Actual Dollars

SD = Standard Dollars

ALC < AD and SLC < SD since labor costs are only a portion of all dollar costs.

X = Product of $\frac{ALC}{SLC}$ and appropriate multiplier.

APPENDIX J

COSTING OF PREDICTED TVE CHANGES

Table J-1

SELECTED PERCENTILES OF ENGINEERED DOLLAR STANDARDS FOR COST CENTERS FROM ORGANIZATION VI

Percentile	Dollar Standard
10	$ 11,218
20	19,915
25	20,887
30	24,748
40	41,511
50	55,715
60	79,741
70	125,940
75	144,150
80	180,520
90	457,000

Mean = $157,780

SD = $252,790

Table J-2

TOTAL PREDICTED CHANGE IN TVE[1] FOR EACH ORGANIZATION, BY PERIOD

	N	C	D	E	F	G	H	I
ORG II	15	-3.20	-3.66	-.91	3.40	1.29	4.87	.28
ORG III	11	-2.14	-4.30	-1.67	.35	.19	-.50	-.98
ORG IV	14	-3.86	-2.80	-2.22	-1.95	.15	.44	-1.28
ORG VI								
Plant 1	31	-.46	-.93	-.49	-.35	.30	.97	-.16
Plant 2	20	-.83	-1.19	-.81	-1.93	-.08	.15	-.73
Plant 3	36	2.27	-4.67	-2.84	-20.86	-1.33	6.36	.11

N = Number of Cost Centers. Number of Work Groups =507

[1]Note: all figures are percentages

APPENDIX K

PREDICTED CHANGES IN ABSENCE

Table K-1

PREDICTED CHANGE IN PERCENTAGE ABS[1] FOR EACH ORGANIZATION, BY PERIOD

	N	C	D	E	F	G	H	I	J
ORG I	10	-11.06	3.97	-.71	-2.37	2.20	-2.03	-3.43	1.88
ORG II	15	.34	2.94	.62	.11	-3.85	-1.10	9.50	.22
ORG III	11	-1.92	.06	-1.30	-.65	.26	.05	.71	.15
ORG VI									
Plant 2	20	-8.44	8.56	2.02	-.47	.31	-6.01	3.57	-.93
Plant 3	36	1.79	5.73	2.96	-7.11	2.50	1.96	-10.16	4.81

N = Number of cost centers. Total number of work groups = 373

[1]Note: all figures are percentages

Table K-2

PREDICTED CHANGE IN PERSON-DAYS ABSENT FOR EACH ORGANIZATION, BY PERIOD

	N	C	D	E	F	G	H	I	J
ORG I	10	-3.3	12.2	-2.2	-7.3	6.8	-6.3	-10.6	5.8
ORG II	15	1.3	10.8	2.3	.4	-14.2	-4.1	35.1	.8
ORG III	11	-43.0	1.3	-29.1	-14.6	5.8	1.1	15.9	3.3
ORG VI									
Plant 2	20	-36.1	36.6	8.6	-2.0	1.3	-25.7	15.3	-4.0
Plant 3	36	11.3	36.0	18.6	-44.7	15.7	12.3	-63.9	30.3

N = Number of cost centers.

APPENDIX L

DOLLAR VALUES OF PREDICTED CHANGES IN TVE AND ABS BY MONTH

Table L-1

DOLLAR VALUE OF PREDICTED CHANGE IN TVE BY MONTH AND ORGANIZATION

	Month T_o^1 +	1	2	3	4	5	6	7	8	9	10	11	12
$ STANDARD = 20,887	ORG II	-764	-764	-764	-190	-190	-190	-190	-190	269*	44*	44*	44*
	ORG III	-898*	-898*	-898	-898	-349	-349	-349*	73*	-205	-205	-205	-205
	ORG IV	-585	-585	-585	-585	-585	-585	-464*	-407	33*	-267*	-267*	-267*
	ORG VI - Plant 1	-96	-194	-194	-194	-102	-102	-102	-102	-33	-33	-33	-33
	Plant 2	-249	-249	-249	-249	-169	-169	-169	-169	-152	-152	-152	-152
	Plant 3	-975	-975	-593	-593	-593	-435	-435	-435	23	23	23	23
	Month T_o^1 +	1	2	3	4	5	6	7	8	9	10	11	12
$ STANDARD = 55,715	ORG II	-2039	-2039	-2039	-507	-507	-507	-507	-507	719*	117*	117*	117*
	ORG III	-2396*	-2396*	-2396	-2396	-930	-930	-930*	195*	-546	-546	-546	-546
	ORG IV	-1560	-1560	-1560	-1560	-1560	-1560	-1237*	-1086	89*	-713*	-713*	-713*
	ORG VI - Plant 1	-256	-518	-518	-518	-273	-273	-273	-273	-89	-89	-89	-89
	Plant 2	-663	-663	-663	-663	-451	-451	-451	-451	-407	-407	-407	-407
	Plant 3	-2602	-2602	-1582	-1582	-1582	-11622	-11622	-11622	61	61	61	61
	Month T_o^1 +	1	2	3	4	5	6	7	8	9	10	11	12
$ STANDARD = 144,150	ORG II	-5276	-5276	-5276	-1312	-1312	-1312	-1312	-1312	1860*	303*	303*	303*
	ORG III	-6198*	-6198*	-6198	-6198	-2407	-2407	-2407*	505*	-1413	-1413	-1413	-1413
	ORG IV	-4036	-4036	-4036	-4036	-4036	-4036	-3200*	-2811	231*	-185*	-185*	-185*
	ORG VI - Plant 1	-663	-1341	-1341	-1341	-706	-706	-706	-505	432	139	-231	-231
	Plant 2	-1715	-1715	-1715	-1715	-1168	-1168	-1168	-1168	-1052	-1052	-1052	-1052
	Plant 3	-6732	-6732	-4094	-4094	-4094	-30070	-30070	-30070	159	159	159	159

*The only prediction available for this organization-month cell was that made by an equation where the organization concerned was not represented in the sample used to develop the prediction equations.

Table L-2

DOLLAR VALUE OF PREDICTED CHANGE IN ABS BY MONTH AND ORGANIZATION

		1	2	3	4	5	6	7	8	9	10	11	12
Cost = $40	ORG I	488	-88	-88	-292	272	272	272	272	-252	-252	-252	-252
	ORG II	432	347†	262†	262†	16	-568	-568	-164*	-164*	1404*	1404*	32*
	ORG III	52*	52*	-1164	-1164	-584	232	232*	44*	44	44	636	132
	ORG IV												
	Plant 2	-1444	-1444	1464*	1464*	344	52*	52*	-1028*	-1028*	612*	612*	-160*
	Plant 3	452	452	1440*	1440*	744	628*	628*	492*	492*	-2556*	-2556*	1212*
Cost = $80	ORG I	976	-176	-176	-584	544	544	544	544	-504	-504	-504	-504
	ORG II	864	694†	524†	524†	32	-1136	-1136	-328*	-328*	2808*	2808*	64*
	ORG III	104*	104*	-2328	-2328	-1168	464	464*	88*	88	88	1272	264
	ORG VI												
	Plant 2	-2888	-2888	2928*	2928*	688	104*	104*	-2056*	-2056*	1224*	1224*	-320*
	Plant 3	904	904	2880*	2880*	1488	1256*	1256*	984*	984*	-5112*	-5112*	2424*
Cost = $120	ORG I	1464	-264	-264	-876	816	816	816	816	-756	-756	-756	-756
	ORG II	1296	1041†	786†	786†	48	-1704	-1704	-492*	-492*	4212*	4212*	96*
	ORG III	156*	156*	-3492	-3492	-1752	696	696*	132*	132	132	1908	396
	ORG VI												
	Plant 2	-4332	-4332	4392*	4392*	1032	156*	156*	-3084*	-3084*	1836*	1836*	-480*
	Plant 3	1356	1356	4320*	4320*	2232	1884*	1884*	1476*	1476*	-7668*	-7668*	3636*

†Calculated as a weighted combination of periods D and E. Weights assigned equal to the proportion of Plants in each period, D and E. Month 2 = .75 D + .25 E; Month 3 = Month 4 = .5 D + .5 E.

*The only prediction available for this organization-month cell was that made by an equation where the organization concerned was not represented in the sample used to develop the prediction equations.

APPENDIX M

PRESENT VALUE OF CHANGES IN PERFORMANCE, DISCOUNTED AT 1% PER MONTH

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Table M-1

PRESENT VALUE OF CHANGES IN TVE, DISCOUNTED AT 1% PER MONTH

		1	2	3	4	5	6	7	8	9	10	11	12
	ORG II	-757	-749	-742	-183	-181	-179	-177	-176	246	40	39	39
	ORG III	-889	-880	-872	-863	-332	-329	-325	68	-187	-185	-183	-182
$ STANDARD	ORG IV	-579	-573	-568	-562	-556	-551	-432	-376	31	-242	-240	-237
= $20,887	ORG VI - Plant 1	-95	-190	-189	-187	-97	-96	-95	-95	-31	-30	-30	-30
	Plant 2	-246	-244	-241	-239	-161	-159	-158	-156	-139	-138	-137	-135
	Plant 3	-966	-956	-576	-570	-564	-410	-406	-4024	21	21	21	20
		1	2	3	4	5	6	7	8	9	10	11	12
	ORG II	-2019	-1999	-1979	-487	-483	-478	-473	-468	665	106	105	104
	ORG III	-2372	-2349	-2325	-2302	-885	-877	-868	180	-499	-494	-489	-485
$ STANDARD	ORG IV	-1545	-1529	-1514	-1499	-1484	-1470	-1154	-1003	82	-646	-639	-633
= $55,715	ORG VI - Plant 1	-254	-508	-503	-498	-260	-257	-255	-252	-82	-81	-80	-79
	Plant 2	-656	-650	-644	-637	-429	-425	-421	-417	-372	-368	-365	-361
	Plant 3	-2576	-2551	-1536	-4980	-1506	-10949	10840	-10733	56	55	54	54
		1	2	3	4	5	6	7	8	9	10	11	12
	ORG II	-5226	-5172	-5121	-1261	-1248	-1236	-1224	-1211	1700	274	271	264
$ STANDARD	ORG III	-6137	-6076	-6016	-5957	2290	-2268	-2245	4660	-129	-1279	-1266	-1254
	ORG IV	-3996	-3957	-3918	-3879	-3840	-3802	-2985	-2596	211	-167	-165	-164
= $144,150	ORG VI - Plant 1	-657	-1314	-130	-1288	-672	-665	-659	-466	-395	-1266	-207	-205
	Plant 2	-1698	-1682	-1665	-1648	-1111	-1100	-1089	-1078	-962	-953	-943	-934
	Plant 3	-6665	-6599	-3973	-3934	-3895	-2832	-28047	-27769	145	144	142	141

Table M-2

PRESENT VALUE OF CHANGES IN ABS, DISCOUNTED AT 1% PER MONTH

		1	2	3	4	5	6	7	8	9	10	11	12
	ORG I	483	-86	-85	-281	259	256	254	251	-230	-228	-226	-224
Cost	ORG II	428	340	254	252	15	-535	-530	-151	-150	1271	1258	28
= $40	ORG III	51	51	-1130	-1119	-556	219	216	41	40	40	570	117
	ORG VI												
	Plant 2	-1430	-1416	1421	1407	327	49	49	-949	-940	554	549	-142
	Plant 3	448	443	1398	1384	708	592	586	454	450	-2314	-2291	1076
		1	2	3	4	5	6	7	8	9	10	11	12
	ORG I	966	-173	-171	-561	518	512	507	502	-461	-456	-452	-447
Cost	ORG II	855	680	509	504	30	-1070	-1060	-303	-300	2545	2517	57
= $80	ORG III	103	102	-2260	-2237	-1111	437	433	81	80	80	1140	234
	ORG VI												
	Plant 2	-2859	-2831	2842	2814	655	98	97	-1899	-1880	1108	1097	-284
	Plant 3	895	886	2795	2768	1416	1183	1171	909	900	-4628	-4582	2151
		1	2	3	4	5	6	7	8	9	10	11	12
	ORG I	1450	-259	-256	-842	776	769	761	754	-691	-684	-678	-671
Cost	ORG II	1283	1020	763	755	46	-1605	-1589	-454	-450	3813	3775	85
= $120	ORG III	154	153	-3389	-3356	-1667	656	649	122	121	119	1710	351
	ORG VI												
	Plant 2	-4289	-4247	4263	4221	982	147	146	-2848	-2820	1662	1646	-426
	Plant 3	1343	1329	4193	4151	2124	1775	1757	1363	1350	-6942	-6873	3227

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